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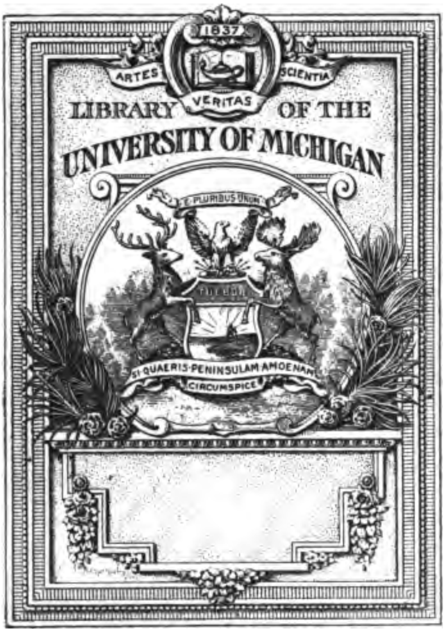
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# BULLETIN

OF THE

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# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

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## No. VI.

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# BULLETIN
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## ARTICLE I.

## ON THE RELICS OF THE STONE AGE IN NEW BRUNSWICK.

BY L. W. BAILEY, M. A.

In the following article, and in another to be subsequently prepared by Mr. G. F. Matthew, it is the wish of the authors to bring together and to publish, for general information, such facts as are known with regard to the distribution, mode of life, and characteristics of the early or pre-historic races once occupying what is now the Province of New Brunswick.

It is hardly to be wondered at that a country possessing so many features likely to prove attractive to savage instincts—a river exceeded in length and volume by but one on the entire Atlantic coast, tributary streams and lakes most remarkable for their size and number, and giving ready access to vast areas abounding in every description of game, and, finally, a coast line not only of great length but of the most diversified character, and rich in the treasures of the sea,—should afford evidence of an aboriginal occupation long prior to the advent of Europeans to our shores. Yet, though implements of stone, chiefly in the form of arrow-heads, are not uncommon in many parts of the Province, and have been somewhat vaguely recognized as of "Indian" origin, no attempt has been made, up to within a short time, to bring such materials together, to examine critically their mode of occurrence, or to make any comparisons between them and similar remains from other parts of the world. Indeed, with the exception of a single article, contained in the Proceedings of this Society, no publication bearing upon the subject of the early inhabitants of this region exists. The opportunities of the authors to supply this want have been less than they could wish, but the material already in hand has proved to be so large as to render impossible its full presentation in a single paper. In this article it is accordingly proposed to consider chiefly such information as has been afforded by inland localities, leaving for a second paper a description of such as are found upon the sea-board. Though such a division is not an exclusive one, a variety of similar articles being found in both situations, yet, as will hereafter appear, it is, to some extent, a natural one, as the conditions of life in the two cases were somewhat dissimilar, and there are many contrasts in the relics which they respectively furnish.

## NATURE OF THE MATERIALS.

The articles to be hereinafter described, and all of which are believed to be of pre-historic origin, may be most conveniently classified with reference to the substances composing them, as follows:

*Group I.—Implements, Weapons and Ornaments of Stone:*

Arrow-heads.
Lance-heads, spear-heads.
Axes and hatchets.
Gouges and chisels.
Celts.
Corn-crushers.
Scrapers.
Hammer-stones.
Net-sinkers.
Ornaments.
Idols and sculptured stones.
Drilled stones.
Flakes
Hearth-stones.
Slick-stones.

*Group II.—Implements and Ornaments of Shell, Bone and Ivory:*

Shell-beads or Wampum.
Harpoons.
Bone awls or piercers.
Bone needles.
Fish-hooks,

*Group III.—Implements of Clay or Earthenware:*

Pottery.
Pipes.

*Group IV.—Food refuse:*

Shell-heaps or kitchen-middens.
Mammalian remains.
Fish remains.
Invertebrate remains.
Vegetable remains.

To these may be added remains of human skeletons, and descriptions of the sites of villages and summer encampments.

### DISTRIBUTION AND MODE OF OCCURRENCE.

The relics above enumerated differ greatly in their relative abundance as well as in their distribution, but are alike in having been invariably met with only in the vicinity of navigable waters, either those of rivers and lakes or of the sea-coast. Of the former, as might be expected, the St. John River affords the most frequent examples; stone implements of various kinds being not unfrequently met with at many points along its banks, at least as far up as Grand Falls. Above this point we have been unable to learn of their occurrence, although both the main river, in its upper portion, and many of its tributaries, such as the Madawaska, Fish River, the St. Francis, and the Allegash, are of a character which would be likely to invite frequent visitation. The occurrence of cataracts, either from the difficulties offered by them to navigation or from the more favorable fishing to be found at their foot, are especially productive, and both the Grand Falls, the Aroostook Falls and the Meductic have yielded implements in considerable variety. But of all inland localities there is none which can compare, both for the number and the diversity of the objects yielded by it, with that of Indian Point and the adjacent waters of the Grand Lake, in Queens County. There can be no doubt that this point was a favourite camping ground for the early races, as it continued to be for some time after the first settlement of the country by Europeans. Indeed it would be difficult to find a position more admirably adapted to meet the wants of a primitive people. Situated near the western extremity of the largest sheet of water in the Province, and at a point where this is connected by short thoroughfares with chains of smaller lakes (Maquapit and French Lakes), as well as with the St. John River through the Jemseg, it was at once a central position from which easy access might be had to a very large area, comprising all the central part of the Province, with rivers abounding even now in fish and game, and one easily capable of defence—the low, swampy character of the land separating it from the St. John River making difficult any hostile approach from that quarter. It is accordingly one of the few localities containing direct evidences of permanent occupancy, and from it many of the most interesting of the articles, to be hereinafter described, have been obtained.

Of the streams of the interior flowing to the so-called North Shore of the Province, we have at present but little information as to the occurrence upon them of pre-historic relics. The only locality known to us is upon the Miramichi River at the mouth of one of its principal tributaries, the Clearwater, of which particulars will be hereafter given.

In most instances the articles above referred to, being implements of warfare or of the chase, have been found simply scattered loose over the surface of the ground or sometimes turned out by the plough—their position being largely a matter of chance. This position has also, undoubtedly, in some cases, been changed from the original one by the agency either of water or ice. Where, however, they are abundant in limited areas, and especially where they are accompanied by heaps of fragments, by implements in various stages of manufacture, or by the blocks from which they were evidently derived, there can be little doubt that such localities were at least temporarily occupied. When, further, the articles found at any one point exhibit much variety, and include objects of ornament, amusement and the like—or still further, when they are accompanied by layers of charcoal, by hearthstones, or by other portions of dwellings, as well as by the remains of animals used as food, there can be little hesitation in regarding them as places of frequent if not permanent resort. In a very few instances the articles found show by their character or associations that their positions are those of sepulture.

The articles found upon the sea-coast differ, both in character and mode of occurrence, from those of the interior and the river valleys. They are usually confined to particular sites, and these show beyond question that they were at least the positions of summer encampments, if not places of more permanent occupation. Their most marked feature is the occurrence of great numbers of refuse shells, forming "shell heaps" or kitchen-middens, similar to those now so well known as occurring along the entire length of the Atlantic coast, as well as in Denmark and other countries. The number of stone implements found in these heaps is much less than in the interior, while they appear to be much more productive of articles composed of shell and bone, as well as in the remains of animals such as may have been used for food. In one instance the remains of a pre-historic village, embracing evidences of a number of associated dwellings, have been observed, and after careful exploration by members of the Society, have been described in their Proceedings.

The articles to be described in the present paper are for the most part those of Groups I. and III. of the classification above given.

## ARTICLES OF STONE.

ARROW-HEADS. These are probably the most common as well as the most widely distributed of stone implements. They are also those in which symmetry of outline and skill in workmanship are most conspicuously displayed. They differ, however, very greatly in this respect among themselves, as they do both in form, size and colour; passing insensibly, as regards the former, into lance and spear-heads, and as regards the latter, from pure white through shades of grey, green and red, to black. The specimens selected for illustration, and contained in Plate I., exhibit their more particular outlines, among which are included leaf-forms (Figs. 5, 6, 7, 9, 11, 14, 30); triangular forms; forms notched at the sides, either broad (Figs. 8, 33), or narrow (Fig. 31); barbed forms (Figs. 30, 34); or forms which are stemmed (Figs. 14, 28), the stem being either straight, tapering or expanding; also lozenge shaped and rhomboid forms.

In all cases the material composing these articles is silicious, but in some it is a pure translucent or a white milky quartz, in others a red jasper, chalcedony, carnelian, brown or black hornstone, or black silicious slate. These materials are all of frequent occurrence among the rocks of the Province, but the first three are especially so, both in veins and as enclosed pebbles in various conglomerates. A large bed of pure translucent chalcedony and blood-red jasper occurs on the southern side of Washademoak Lake, but much of this material would seem to have been derived from the conglomerates of the Lower Carboniferous formation, or the debris of the latter.

In all cases the arrow-heads here described have been formed by a process of chipping or flaking, probably by the agency of pressure slowly applied. In no instance do they show evidence of grinding.

LEAF-SHAPED IMPLEMENTS. (Plate III. Figs. 15–22). These are implements of uncertain use, but may have been used for cutting, for scraping, or for splitting purposes. They vary from broadly oval to ovate and narrow lanceolate forms, and are usually quite thick along the medial line. They may be pointed at one or both ends, and in all instances have been formed by flaking.

AXES AND HATCHETS. (Plate III. Figs. 1, 4, 5, 6). These are among the most common of Indian relics and have been found at many different localities. They were especially abundant at Indian Point, from which, however, they have now been mostly removed.

In size, these articles vary from four or five to twelve inches, and from three to five inches in breadth, the butt-end being an inch or more in thickness, but with a more less defined encircling groove for the attachment of a handle. In addition to the differences of form, they also differ from the articles previously noticed, in having been shaped by pecking or grinding rather than by flaking, their surfaces being always smooth and occasionally somewhat polished. The cutting edge is usually dull or even rounded. The material of their construction is also different from that of the arrow and lance-heads, being composed usually of hard sandstone or quartzite, and occasionally of grey syenite, but in no instance of either pure quartz, jasper or chalcedony.

They are all oval in section, but in some the oval is greatly flattened, the maximum thickness not exceeding an inch, and bevelled to either end as well as to the sides; others exhibit a very thick or rounded butt, and from this taper abruptly to the cutting edge, thus combining, as in many modern implements, the use of the axe and hammer.

LANCE AND SPEAR-HEADS. (Plate II. Figs. 1, 5 and 10). The articles included under this head bear much resemblance to some of the forms of arrow-heads above described, both in general form and in material, but differ in being usually of considerably larger size, with a tendency to more elongated shapes, and less perfect accuracy of outline. They occur both with and without stems, and occasionally are notched at the base, those with stems having been perhaps fastened by mere insertion, and the notched forms with the assistance of thongs. Red and black jasper would seem to have been the favourite materials in their construction; but one very beautiful specimen in our collection, from the Tobique River, is a clear and almost transparent vitreous quartz, irregularly clouded with dark intersecting veins. It has a diameter at the base of two and a half inches, and is distinctly stemmed. Like the arrow-heads, these articles have all been made by a process of flaking.

CUTTING IMPLEMENTS. (Plate III. Fig. 12). Among the specimens possessing a general lance-like form, are some of which the size and weight suggest that they may have been held directly or with a short handle, and have served for cutting or hewing rather than for purposes of projection. A fine specimen of this kind, composed of red jaspery slate, has a length of nine inches, tapering at one end to a rounded point and narrowed to a sort of handle at the other, while either side is bevelled from the median line to a rather sharp edge. Others are like arrow-heads in size and shape, but are left thick and blunt on one side, with a cutting edge on the other. They are always flaked.

**ORNAMENTED STONES.** (Plate II. Figs. 6, 7, 8). Among the articles found at Maquapit Thoroughfare, near Indian Point, Grand Lake, are several which are interesting as exhibiting attempts at surface ornamentation. In each case these objects are of a narrow lanceolate form, tapering at one end to a point and hence bearing some resemblance to spear or lance-heads; but in each case the flattened sides are markedly divided into three well-defined parallel zones, which run the whole length of the article and are inclined to each other at a considerable angle, while (on one side only) the central, or all three of these zones, is conspicuously marked and ornamented with incised lines. Where central, these lines run obliquely down from right to left at an angle of 45°, and are remarkable for their regularity, and in one instance, for their number and fineness; but when found on all three faces, those on the sides are uniformly oblique (downward from right to left), while those of the middle form a more complex pattern, inclining right and left alternately in zigzag fashion. In two instances the material composing these ornaments is a fine black slate, in another a light colored and apparently magnesian slate. The fineness of the incisions points to the use of sharply pointed instruments and a considerable degree of skill in their manufacture. They are represented in Plate II., Figs. 6, 7, 8, but owing to the delicacy of the markings, these can scarcely be recognized in the photograph.

**HAMMERS AND HAMMERSTONES.** (Not figured). The articles included under this head are, from their nature, somewhat indefinite and variable, any stone, of whatever shape, having been at times used, if convenient, for the purpose of hammering. In some instances the fact of their having been so employed is indicated only by the worn or indented edge of the surface used for striking; but in other cases the whole specimen has been artificially modified in form so as the better to adapt it to its purpose. Of the latter class we have several specimens (from Maquapit Thoroughfare), having a general wedge-like or axe-like form, but with one lateral edge thick and rounded, while the other is thin and at the same time distinctly lobed or crenate, as though from the effects of repeated blows, the stone being probably held in the hand by the narrow extremity. Others are simply rounded or ovoidal pebbles, more or less worn on the sides. The more typical forms are from four to five inches in length and are composed of a hard fine grained sandstone.

GOUGES AND CHISELS. (Plate III. Figs. 7, 23 and 25). Gouges are not of uncommon occurrence and are in many instances remarkable for the perfection and symmetry of their finish, the surfaces being regular, smooth and often even polished. They vary in length from four to eight inches, being about an inch or an inch and a half broad in the middle, whence they taper to a somewhat pointed extremity at one end and to an abruptly truncate one at the other. The gouge-like form is determined by a more or less broad and deep groove which, beginning with a slight depression at the narrower end, broadens and deepens towards the other, giving to the truncate extremity a sharp and crescentic cutting edge. These implements are usually composed of fine sandstone or slate and have been formed by a process of rubbing.

The chisels are of similar material and mode of manufacture, but are flat instead of crescentic in section, with one end rough and blunt, and the other rubbed down, more or less abruptly, to a fine cutting edge. Those in our possession are from four to six inches in length. Some of the articles thus designated may have been used as "scrapers."

CELTS OR WEDGES. (Plate III. Figs. 8, 9, 24, 26). These are much like the axes in general form, as well as in size and material, and may occasionally have been used like the latter, but differ in being destitute of any encircling groove or other evidence of attachment. They are very common and were probably used, in connection with stone hammers or axes, for the splitting of trees. Among those possessed by us is one which is rather unique in being composed of a beautiful dark green jade and very highly polished. It was found upon the shore of the St. John River below Spoon Island.

CORN-CRUSHERS. (Plate III. Figs. 2 and 3). These implements are so called from their form, resembling closely that of a pestle, and their weight, showing that they must have been employed for pounding or crushing. They are not of very common occurrence, the only two specimens known to us having come from the same locality, viz., the neighbourhood of Grand Falls. The one now in our possession is twenty-one inches long and of cylindrical shape, having a general diameter of about three and a half inches, but having the larger or butt end rounded and the other narrowed just below its extremity to a sort of neck, apparently for convenience of handling. It is composed of a hard grey sand stone or quartzite and weighs not less than twelve pounds.

PENDANTS OR NET-SINKERS. (Plate II. Figs. 15–18). These objects were evidently designed for suspension, but whether for purposes of ornament or use, cannot always be readily determined. In general, however, their weight would suggest that they were employed for some other purpose than personal adornment, while their close resemblance in form to the modern plummet and to the sinkers used in fishing, render it possible that this was their chief use. Their general outline is pear-shaped, but while some are regularly rounded, others have more or less flattened parallel sides; and while some are broadest in the middle, tapering to either end, others, like plummets, are expanded below, and others again are bottle-shaped, possessing a distinct elongated square or quadrate neck. They all, however, possess the common feature of a groove around the narrow end, bordered externally by a sort of ring or collar, and thus adapting them to purposes of suspension. The material used is sometimes a fine hard sandstone, which has been shaped apparently by *pecking*, but in several instances a bright red slate has been employed, the surfaces of which have been ground down and flattened by a process of rubbing.

Perforated Stones. Our collection contains several of these articles from Maquapit Lake, the purpose of which can only be conjectural. They are simply flat pebbles, of irregular form, and which would not attract attention were it not that they occur with other undoubted Indian relics, and show perforations which close examination shows to have been artificially made. They may have been employed as sinkers.

### II.—IMPLEMENTS OF SHELL AND BONE.

1. Shell Beads or Wampum. (Plate II. Fig. 1.) The only examples of the latter which have come under our notice were obtained some fifteen years ago from the Tobique River, in Victoria County, where they were found, in connection with human bones, apparently those of a child, and wrapped in bark, buried beneath several feet of soil. They are all circular and slightly concavo-convex, the outer diameter being about three-eighths, and that of the central perforation about one-eighth of an inch. They would appear to have been derived from the common fresh water clams (*Unio* and *Anodonta*) and, considering the circumstances under which they were found, were probably of true Indian and domestic manufacture, rather than imported or imitative products, such as were abundantly made for purposes of barter, in more thickly settled localities. Together with the accompanying bones, a large part of the shells obtained at the locality are now in the cabinet of the Smithsonian Institution at Washington, D. C.

2. The only implement of bone in the possession of the author was obtained from one of the shell heaps found near Oak Bay, in Charlotte County. It is apparently a fragment of a tibia, which at one point on the edge or stem shows a deep nick or lobe, cut in obliquely, and apparently with the object of producing a sort of bodkin by which threads might be caught and pulled through loops, as in the making of

netting and the like. In this and other shell-heaps of the coast, a considerable variety of such articles, in the form of needles, fish-hooks, harpoons, etc., occur, and will be fully described and figured in a later article.

### III. IMPLEMENTS OF CLAY OR EARTHENWARE.

1. POTTERY. (Plate II. Figs. 12 and 14). So far as known to the authors, examples of aboriginal pottery have been found at three localities only, viz.: the Maquapit Thoroughfare, near Grand Lake, and two stations where shell heaps occur upon the coast. They were first brought to our notice along the Maquapit Thoroughfare by Mr. J. W. Bailey, in 1881, who, in visiting the locality in the course of a canoe voyage, and while collecting other Indian remains, was led to notice the occurrence of fragments of pottery mingled with the latter. In a subsequent visit to the locality by the author of this paper, a careful search of both shores of the Thoroughfare was made, and in addition to numerous other articles, chiefly of stone, many fragments of pottery were obtained. They were found to be confined to a very limited area, and this, too, only accessible at low water, being strewn over the surface of the soft muddy banks or imbedded in the latter. None of the fragments are sufficiently large to convey any certain idea of the form of the vessel from which they were derived, but, having undergone apparently but little change, they afford a good idea of the general composition of the aboriginal earthenware as well as of the modes and patterns of its ornamentation. The materials have usually about the texture of fine mortar, though some are much finer, and seem to consist of a mixture of clay with spangles of black mica and pulverized shells. The outer surface, except where indented, is usually quite smooth, and covered by a reddish ochreous glaze. The indentations are evidently designed for ornament, and are arranged in regular lines or rows, commonly straight and parallel, but occasionally curved, intersecting or zig-zag. Some consist of a succession of well defined triangular or rounded dots, others of continuous lines, the latter occurring

chiefly on what would seem to have been the rim or margin of the bowl-like vessels. In some instances the arrangement of the indentations bears some resemblance to net-work, but the form of the individual impressions would seem to show that they are not the result of cordage, as is sometimes the case with aboriginal pottery, but rather that of blunt toothed implements pressed against the sides of the article while the latter was still soft. The fragments are in most instances quite firm, but lack the hardness of real earthenware. and could hardly have been subjected to any great degree of heat. As stated, the fragments found have been too small to give any definite idea either of the form or dimensions of the vessels of which they formed a part.

2. PIPES. (Plate II. Fig. 9). We have but a single specimen of an aboriginal pipe, but this one of somewhat unique character and remarkably well preserved. It was given to Mr. J. W. Bailey by a person living near Aroostook Junction in Victoria County, and said by him to have been obtained from near the basin below the Aroostook Falls. Whether or not this is the exact locality of its first discovery, there can be no question as to its authenticity as an Indian relic, Major Powell, of the United States survey, and one of the best authorities on this subject, to whom it was shown, has stated that it is not only a genuine, but a typical example. The best idea of its form will be obtained from the figure representing it, the most noticeable peculiarity being the strongly marked Indian face, imprinted, not as usual upon the front, but upon the inner side of the bowl facing the stem. The material composing it is quite hard and of rather coarse texture within, but the outer surface is everywhere smooth or slightly polished, the whole looking like a fine sandstone but probably of artificial manufacture. In proportion to the whole size of the bowl (one and one-half inches high by one inch broad), that of the opening is very small, being only a little over half an inch where widest and abruptly narrowing to the diameter of a lead pencil. The stem end is a little over an inch long and makes with the bowl an angle of 120°.

## EXPLANATION OF PLATES.

*Plate I. Arrow-Heads. Mostly from Maquapit Lake, Queens County:*

Figures 1–10, 13, without stems. Figures 10, 12, 14–28, stemmed.
Figures 30–34, notched.

*Plate II.:*

Figures 1–5, 10, lance-heads, Maquapit Lake.
" 6, 7, 8, lance-heads, ornamented with incised lines.
" 12, 14, fragments of pottery, Maquapit Lake.
" 13, shell-beads or wampum, Tobique River.
" 15–18, sling-stones, plummets, or net-sinkers, Maquapit Lake.

*Plate III.:*

Figures 1, 5 and 6, stone axes.
" 2 and 3, corn-crushers, upper St. John River.
" 7, 23, 25, gouges.
" 4, 8, 9, 24, celts or wedges.
" 12, lance-head.
" 13–19, arrow-points.
" 20, perforated stone.

The photographs above referred to were in part taken by Mr. R. W. Hanington, of Dorchester, and in part by Mr. G. W. Schleyer, of Fredericton. Mr. Hanington, a member of the junior class in the University, very kindly undertook to do the entire work, but after devoting considerable time thereto, was compelled by serious illness to desist, and the task was necessarily transferred to another.

## ARTICLE II.

# THE MARINE MOLLUSCA OF NEW BRUNSWICK.

BY W. F. GANONG.

## PART I.—INTRODUCTION.

(Read November 2nd, 1886.)

Probably the very earliest published reference to the Invertebrate Zoology of this region occurs in "Les Voyages du Sieur de Champlain," written by Champlain, and published in Paris in 1613. He found on St. Croix Island (now Neutral or Dochet Island), in 1604, cockles, mussels, sea-urchins and sea-snails. His own words are: "Antour de notre habitation il y a de basse mer quantité de coquillages, comme coques, moulles, ourcins & bregaux qui faisoyent grand bien a chacun." * Another interesting early reference to our invertebrates is that of Nicholas Denys, who, in his "Déscription Géographique et Historique des Costes de L'Amérique Septentrionale," published at Paris in 1672, mentions the abundance of shell-fish (coquillages) upon our North Shore, and of oysters (huistres) at Cocagne.

Many early books on New Brunswick give short lists of the edible species of mollusca and crustacea, with an occasional isolated reference to the radiata. The greater number of these books, however, having been intended merely as guides for the information of immigrants, such a subject as the zoology of the Province could be treated only in the briefest and most practical way; but their writers evidently had no conception of the richness of marine life in our waters, and knew nothing of its study in a scientific sense. The chief lists, bearing marks of having been copied more or less the one from the other, occur in works by Robert Cooney (1832),

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* A still earlier publication (Lescarbot's History of New France, 1609), in describing Champlain's voyage, mentions the abundance of mussels at St. Croix Island.

Rev. C. Atkinson (1844), C. L. Hatheway (1846), Abraham Gesner * (1847), W. H. Perley (1852 and 1854), and Alex. Monro (1855).

The first section of New Brunswick to be systematically studied by a naturalist, was the region about Grand Manan. William Stimpson, afterwards Dr. Stimpson, spent three months in the summer of 1852 at work upon the study of its marine invertebrate fauna. The results of that work, including the descriptions of many new genera and species, were published in 1854 in Vol. VI. of the Smithsonian Contributions to Knowledge. The publication of this list marks the beginning of the scientific study as well as of the scientific knowledge of the invertebrates of this Province. An earlier paper, by the same author, contains references to species found at Grand Manan and Eastport, but they are incidental, the paper not dealing specially with the fauna of these two places.

The next work of importance in which occur references to the mollusca of the southern coast is the second edition of "Gould's Invertebrate of Massachusetts," an illustrated edition comprising the mollusca only, published in 1870. The first edition of this work, published in 1841, contains no references to New Brunswick.

We owe much, too, to the investigations and dredgings of the United States Fish Commission. The latter have added very greatly to our knowledge of the distribution of species in the Bay of Fundy, particularly in the region about Grand Manan and Eastport. The various papers by Professor A. E. Verrill, embodying these results in so far as they relate to our waters, are mentioned at length below.

Of the molluscan fauna of the Bay Chaleur and Gulf of St. Lawrence coasts we have less knowledge. A paper published in the "Canadian Naturalist" in 1869, by Robert Bell, contains a few references to New Brunswick. This, together

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* Upon this subject a note of Gesner's (in his "New Brunswick") is misleading. He says: "Of shells the number collected is 131; crustacea 27. These have been arranged according to the system of Lamarck by T. A. Greene, Esq., of New Bedford, and appear in the catalogue of the animals of Massachusetts." Upon consulting this list, which was published in the second edition of Hitchcock's Zoology of Massachusetts (1835), it will be found that it includes the mollusca of the whole New England coast, and is not a list of the shells of New Brunswick, as a reader of Gesner's work would naturally infer.

with three or four papers by J. F. Whiteaves, treating only incidentally of our waters, are all that have been published upon the fauna of the northern coast. Mr. Whiteaves has dredged in the Gulf of St. Lawrence; but by no means zoologically, even if geographically, can the latter be considered to be among the coast waters of New Brunswick. So different is the character of the life in Northumberland Straits and along the coast to and in the Bay Chaleur, that there is a natural separation of these waters from the Gulf of St. Lawrence proper, which gives a natural zoological division between the former, which certainly are coast waters of New Brunswick, and the latter which is not.

By New Brunswick students, practically nothing has been done. Mr. G. F. Matthew and Rev. C. H. Paisley have published lists of shells from the post-pliocene deposits of this Province; but aside from a popular and very incomplete paper by the writer, published in Bulletin No. IV. of the Natural History Society of New Brunswick, nothing has appeared upon the living forms. Very little is as yet known of the distribution and relative abundance of the species upon our coasts, and an attractive field here lies open to our young students of natural history.

The general character of the fauna of the southern coast is strongly arctic, though it is by no means of an extreme type. The great tides of the Bay of Fundy causing, as they must, strong currents, sweep the cold water of the northern Atlantic into the Bay, over amongst the Grand Manan Islands and against the New Brunswick and Maine coasts. The deep waters of this region have no chance to become warm, the constant influx and circulation of cold currents keeping the temperature always reduced.

But upon the "North Shore" there is a very different condition of things. The waters are shallow and the tides slight. There is no great influx of cold water and the waters easily become warm and retain their warmth. These conditions are favourable to the existence there of a more southern fauna than can live in the Bay of Fundy, and we find as a matter of fact that all along the coast in Northumberland

Straits and thence up to Caraquette and in the Bay Chaleur, the animal life is decidedly of a more southern type. Shells are found in these waters which do not thrive elsewhere north of Cape Cod, except at one or two isolated and very sheltered localities. A very conspicuous and familiar example of this is afforded by the oyster. It is abundant on the North Shore and formerly occurred at several points on the New England coast. It is now, however, altogether extinct north of Massachusetts Bay, with this single exception. The persistence of this assemblage of southern forms amid the cold northern waters, shut off as it is from the similar fauna far to the south, is readily explained by the physical conditions of the region mentioned above. But how it came to be there, or the conditions which determined its connection with and severance from the fauna now south of Cape Cod, have not been satisfactorily explained. We have then, literally, upon our northern shore a southern fauna, and upon our southern shore a northern fauna.

The following list is believed to include all works and papers of importance published up to the present time which relate to the marine molluscan fauna of New Brunswick. Papers which contain one or a few isolated references are omitted, but in the list of our mollusca which follows they are specially referred to when necessary. The following may be considered, then, to be comprehensive Bibliography of New Brunswick Malacology in so far as the latter relates to distribution.

A. (1851). Revision of the Synonymy of the Testaceous Mollusks of New England. By William Stimpson. Boston, 1851. Contains a few references to species found at Eastport and Grand Manan.

B. (1854). Synopsis of the Marine Invertebrata of Grand Manan: or the region about the mouth of the Bay of Fundy, New Brunswick. By William Stimpson. Smithsonian "Contributions," Vol. VI., 1854. An accurate and systematic catalogue with notes on the distribution, etc., of the invertebrates of these waters. It mentions 117 species of molluscs, to which number many have since been added by the explorations of the United States Fish Commission.

C. (1859). On the Natural History of the Gulf of St. Lawrence, and the distribution of the Mollusca of Eastern Canada. By Robert Bell, Jr. "Canadian Naturalist," Vol. IV., page 197, June, 1859. Contains a few references to New Brunswick waters.

D. (1869) On the Marine Mollusca of Eastern Canada. By J. F. Whiteaves, F. G. S., Etc. "Canadian Naturalist," new series, Vol. IV., page 48, March, 1869. Mentions some species as occurring in New Brunswick.

E. (1870). Report on the Invertebrata of Massachusetts Second edition, comprising the Mollusca. By Augustus A. Gould, M. D. Edited by W. G. Binney. Boston, 1870. By far the most complete work we have upon New England Mollusca. It is well illustrated and an invaluable work to students of our fauna. It refers frequently to New Brunswick waters.

F. (1873.) Report upon the Invertebrate Animals of Vineyard Sound and the adjacent waters, etc. By A. E. Verrill. Published in the report of the United States Fish Commission for 1871–72. Washington, 1873. Contains many references to the Bay of Fundy and Eastport harbour.

G. (1873). Results of recent Dredging Expeditions on the Coast of New England. By A. E. Verrill. "American Journal Science," third series, Vol. V., January, 1873. Mentions the occurrence of some species in the Bay of Fundy.

H. (1874). Report on Deep-Sea Dredging Operations in the Gulf of St. Lawrence. By J. F. Whiteaves. Report to the Minister of Marine and Fisheries, pamphlet form, Ottawa, 1874. Contains much of importance upon the life of the northern and eastern coast waters.

I. (1874). On recent Deep-Sea Dredging Operations in the Gulf of St. Lawrence. By J. F. Whiteaves. "American Journal Science," third series, Vol. VII., page 210, March, 1874. Reprinted in "Canadian Naturalist," new series, Vol. VII., page 336, November, 1874. Very important as adding to our knowledge of the southern fauna of the northern and eastern coasts, but embodying many of the results of the last (H).

J. (1879). Notice of Recent Additions to the Marine Fauna of the Eastern Coast of North America. By A. E. Verrill. "American Journal Science." third series, Vol. XVII., April, 1879. Refers to Bay of Fundy species.

K. (1880). Notice of Recent Additions to the Marine Invertebrata of the North-eastern Coast of America, etc. By A. E. Verrill, "Proc. United States National Museum," Vol. III., page 356, 1880. Refers to Bay of Fundy species.

L. (1880–81). The Cephalopods of the North-eastern Coast of America," Part II. The smaller Cephalopods, including the "Squids," etc. By A. E. Verrill. "Trans. Connecticut Academy of Arts and Sciences," Vol. V., June, 1880, August, 1881. A very complete work on the Cephalopods of the Bay of Fundy.

M. (1882). Notice of Recent Additions to the Marine Invertebrata of the North-eastern Coast of America. By A. E. Verrill. "Proc. United States National Museum," Vol. V., page 315, 1882. Refers to Bay of Fundy species.

N. (1882). Catalogue of Marine Mollusca added to the Fauna of the New England Region, during the past ten years. By A. E. Verrill. "Trans. Connecticut Academy, Vol. V., page 447, April–July, 1882." The following catalogue is intended to include all the mollusca now known to inhabit the New England region that are not included in Binney's edition of Gould's Invertebrata of Massachusetts, published in 1870. In the New England region I include, on the north, the coasts of Nova Scotia and New Brunswick and their outlying banks."

O. (1885). On the Zoology of the Invertebrate Animals of Passamaquoddy Bay. By W. F. Ganong, B. A. "Bulletin Natural History Society of New Brunswick," No. IV., page 87, 1885. A brief paper, mentioning the occurrence of some common species.

To these, Tryon's "Manual of Conchology," a very comprehensive work, now being published in parts, might be added. It will assist the student in the identification of all of our species, and contains an occasional reference to our fauna.

In the following list, the order and arrangement, and as far as possible, the nomenclature of the species, follows those of Binney's Gould. This work, though now rare and expensive, is really the only one in existence which treats of our mollusca in a way of use to our students. Since its publication there have been some changes in nomenclature, but as the next sixteen years will probably see as many more, it has been thought best upon the whole to keep as far as possible to that of this work. In most cases, where there is a later and better name, it is given along with the older one. In the list all of the names from Binney's Gould are printed in heavy type, all names printed in smaller type are those of species which are not referred to in the latter work, but are from others.

No synonymy of the species has been attempted, beyond what is absolutely required for a proper understanding of the authorities quoted. Where an author uses for a certain species a name different from that of Binney's Gould, it is of course necessary to give the former in full. In giving the authorities for the names used, the latest and best rule on the subject is followed, *i. e.*, the name of the first author to use the specific name is given in brackets, and after it that of the one who first used the combination of generic and specific names. Where the original describer of the species placed it in the genus in which it still remains, his name is given alone without brackets. A few errors in this regard in Binney's Gould have been corrected in the list, but the authority of names quoted from other papers are given as they occur in the latter. The capital letters refer of course in all cases to the corresponding papers in the bibliography above. The terms litteral, coralline, etc., used in describing the distribution in depth of the species, have their usual meaning. The litteral zone is the belt between high and low-water marks; the laminarian from low-water mark to fifteen fathoms, and the coralline from fifteen to fifty fathoms.

No sharp line can be drawn between those waters which are coast waters of New Brunswick and those which are not, which is at the same time geographical and zoological. For reasons already stated, the Gulf of St. Lawrence is not included among our coast waters. Eastport harbour belongs as much to us as to Maine, and is considered in the list as among our waters. Out of deference, however, to the geographical line, those species which occur in Eastport harbour, but nowhere else in New Brunswick, are given in a separate list. For all localities for which authority is not given, the writer is alone responsible.

**Harvard University, Cambridge, Mass., October, 1886.**

## PART II.

# A PRELIMINARY LIST OF THE MARINE MOLLUSCA OF NEW BRUNSWICK.

COMPILED AND EDITED BY W. F. GANONG.

## Class CEPHALOPODA.

1.—OCTOPUS BAIRDII.—Verrill.

"From five different localities in the Bay of Fundy." "Off Head Harbour, Campobello Island, in seventy-five and eighty fathoms, shelly; off Herring Cove in sixty fathoms, muddy; off Grand Manan in one hundred and six fathoms, gravel and sand." *Verrill* (G), also (L).

2.—LOLIGO PEALEI.—Lesueur. (Long-finned squid).

St. Croix River.

Neither this species nor its varieties *borealis* and *pallida* have, up to the present time, been reported from Maine or New Brunswick waters. Professor Verrill (L) says: "It has not been observed north of Cape Ann." In June, 1886, the writer found two specimens either of this species or of its variety *borealis*, in a weir at Devil's Head, in the St. Croix River. Mr. Henry Frye, of Frye's Island, New Brunswick, a thoroughly practical observer, has told the writer that there are in our waters two kinds of squid, "the short-tailed and the long-tailed" The former is undoubtedly the next, (No. 3), of this list, and the latter must be either this species or the variety *borealis*. It, therefore, certainly belongs to our marine fauna, but its exact variety, its abundance, and its distribution are still to be determined.

3.—OMMASTREPHES ILLECEBROSA.—Verrill. (Short-finned squid.)

Eastport and Bay of Fundy, *Verrill*, (F), (L). Passamaquoddy Bay, and all waters of southern coast.

This is the common squid of our waters. It is probably the one Stimpson (B), reports from Grand Manan and calls *Laligo Bartramii;* his mistake is explained by the fact that he did not see it himself, but knew it only from fishermen's descriptions. It is this species which W. F. Ganong (O), reports as abundant in Passamaquoddy Bay.

The descriptions and figures of Cephalopods in Binney's Gould (E), are nearly valueless for the identification of species. According to Verrill (F), (L), the figure of *Lilogopsis pavo* in that work is doubtless meant for *O. illecebrosa* and *O. Bartramii* for *Loligo Pealei.*

## Class GASTEROPODA.

4.—ADMETE VIRIDULA.—(Fabr.) Stimpson.

Grand Manan, coralline zone, *Stimpson* (A), (B). Eastport, *Stimpson* (A), *Gould* (E). In stomachs of fishes (E).

5.—TRICHOTROPIS BOREALIS.—Sowerby.

Grand Manan, coralline zone, *Stimpson* (B). West Isles, *Stimpson* (A). Eastport, twenty f., *Gould* (E).

6.—CERITHIOPSIS COSTULATA.—(Möller). Sars.

Bay of Fundy, *Verrill* (N).

7.—FASCIOLARIA LIGATA.—Mighels & Adams.

PTYCHATRACTUS LIGATUS. Stimpson (F).

Bay of Fundy, off Campobello, twenty to thirty f., gravel, *Stimpson* (A). Grand Manan, twenty-five f., *Stimpson* (B). Bay of Fundy, fifteen to sixty f., *Verrill* (F).

8.—TROPHON CLATHRATUS.—(Linn.) Stimpson.

TRITONIUM CLATHRATUM. Müll (A), (B).

Grand Manan, *Stimpson* (A), (B). Eastport, in fishes' stomachs, *Gould* (E).

9.—TROPHON CLATHRATUS *var* GUNNERI Lovèn.—(N).

TROPHON GUNNERI, Lovèn (G).

Bay of Fundy, off Grand Manan, *Verrill* (G).

10.—FUSUS DECEMCOSTATUS.—Say.

TRITONIUM DECEMCOSTATUM. Midd. (A), (B).

"Passamaquoddy Bay, in mud at low water," *Stimpson* (A). Grand Manan, low-water mark to forty f., *Stimpson* (B). Eastport, *Gould* (E). L'Etang harbour and Passamaquoddy Bay, *Ganong* (O).

This handsome shell, which may be called the "ten-ribbed spindle-shell," is abundant everywhere on the southern coast in clear water, on sand or mud bottoms. It is particularly large, fine, and abundant about low-water mark at Hospital Island, Passamaquoddy Bay.

11.—FUSUS PYGMAEUS.—Stimpson.

TRITONIUM PYGMAEUM. Stimpson (A), (B).

NEPTUNEA PYGMAEA (F).

SIPHO PYGMAEUS. Gould (I).

Eastport, six to fifty f., *Stimpson* (A). Grand Manan, *Stimpson* (A), (B). Bay of Fundy, low-water to one hundred f., *Verrill* (F). Northumberland Straits, *Whiteaves* (I).

12.—FUSUS ISLANDICUS.—(Gmêlin), Martini. (Spindle-shell).

Tritonium Islandicum. Lovèn (A), (B).

Neptunea curta. Verrill (F).

Eastport, low water, *Stimpson* (A). Grand Manan, low-water mark to forty f., *Stimpson* (B). Bay of Fundy, low-water mark to eighty f., *Verrill* (F). Hospital Island, Passamaquoddy Bay, *Ganong* (O).

13.—BUCCINUM UNDATUM.—Linn, (Whelk).

Reported by all observers from all localities examined on southern coast. Northumberland Straits, *Whiteaves* (I). Littoral zone to one hundred f., *Verrill* (F).

This is one of the most common Gasteropods on the southern coast. It is found alive everywhere in the littoral zone; while dead shells are numerous above high-water mark, having been either washed up by the waves or carried by crows.

14.—NASSA TRIVITTATA.—Say.

Tritia trivittata. Adams (F).

Grand Manan, (rare), *Stimpson* (B). "Plentiful in Bay Chaleur as far up as Dalhousie," *Bell* (C). Eastport, *Gould* (E). Bay of Fundy, three to thirty f., *Verrill* (F). Shediac and Northumberland Straits, *Whiteaves* (I). Passamaquoddy Bay, *Ganong* (O); also in L'Etang and Bliss harbours.

15.—NASSA OBSOLETA.—Say.

Bay Chaleur, *Whiteaves* (D). Point duChene, *Whiteaves* (H). Shediac, *Whiteaves* (I).

16.—PURPURA LAPILLUS.—Lamarck, (Purple shell).

Reported as abundant by all observers upon the southern coast.

It is one of the most common littoral species and is quite variable. The three-banded white and yellow varieties occur frequently, while the form and sculpturing of the shell are subject to much variation.

17.—COLUMBELLA LUNATA.—Sowerby.

ASTYRIS LUNATA Say. (I).

Shediac, *Whiteaves* (I).

18.—COLUMBELLA DISSIMILIS.—Stimpson.

ASTYRIS ZONALIS. Verrill (F).

Eastport, *Stimpson* (A). Grand Manan, eight f., *Stimpson* (A), (B). Eastport, ten to sixty f., *Verrill* (F).

19.—COLUMBELLA ROSACEA.—(Gould), Stimpson.

ASTYRIS ROSACEA. H. and A. Adams (F).

West Isles, ten f., gravel, *Stimpson* (A). Grand Manan, deep water, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, eight to sixty f., *Verrill* (F).

20.—BELA PLEUROTOMARIA.—(Couthouy), Adams.

MANGELIA PYRAMIDALIS. Stimpson (B).

Grand Manan, *Stimpson* (A), (B). Eastport, *Gould* (E). Bay of Fundy, not uncommon, eighteen to sixty f., *Verrill* (F). Eastport harbour and Bay of Fundy fifteen to eighty f., *Verrill* (N).

21.—BELA CANCELLATA.—(Mighels), Stimpson.

MANGELIA CANCELLATA. Stimpson (B).

Grand Manan, twenty-five f., *Stimpson* (B). Bay of Fundy near Eastport and Grand Manan, ten to one hundred f., common, *Verrill* (M), (N). Northumberland Straits, *Whiteaves* (I), (H).

22.—BELA DECUSSATA.—(Couthouy), H. and A. Adams.

MANGELIA DECUSSATA. Stimpson (B).

Grand Manan, *Stimpson* (B). Eastport, Bay of Fundy, "not rare," twenty to one hundred f., *Verrill* (N).

23.—BELA VIOLACEA.—(Migh. and Ad.) H. & A. Adams.

BELA BICARINATA. (Couth.), Verrill, *var* VIOLACEA, (Mighels & Adams) (N).

Eastport harbour and Bay of Fundy, ten to fifty f., *Verrill* (N).

24.—BELA HARPULARIA.—(Couth.), H. and A. Adams.

MANGELIA HARPULARIA. St. (A).

Eastport, *Stimpson* (A). Eastport and Bay of Fundy, ten to ninety f., *Verrill* (F), (M), (N).

25.—BELA TURRICULA.—Stimpson.

MANGELIA TURRICULA. F. et H. (B).

BELA SCALARIS. (Möll), H. and A. Adams.

Grand Manan, twenty-five f., *Stimpson* (B). Eastport and Bay of Fundy, ten to ninety f., *Verrill* (N).

26.—BELA EXARATA.—(Möller), H. and A. Adams.

Bay of Fundy, *Verrill* (K). Grand Manan, five to eight f., *Verrill* (N).

27.—BELA RUGULATA.—(Möller), H. and A. Adams.

(BELA GOULDII. Verrill (N)).

Bay of Fundy, *Verrill* (K).

28.—BELA INCISULA.—Verrill.

Eastport harbour and Bay of Fundy, five to one hundred and ten f., *Verrill* (M), (N). "Off Shediac, ten f., collected by J. F. Whiteaves," *Verrill* (N).

29.—PLEUROTOMA BICARINATA.—Couthouy.

Bay of Fundy, rare, *Verrill* (F).

30.—BULBUS FLAVUS.—(Gould), Stimpsen.

NATICA FLAVA. Gould (B).

Grand Manan, fifty f., *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, *Verrill* (F).

31.—MAMMA (?) IMMACULATA.—(Totten), Stimpson.

NATICA IMMACULATA. Tott. (A), (B).

LUNATIA IMMACULATA. Adams (F).

Eastport, 5 f., mud, *Stimpson* (A). Grand Manan, low water to twenty-five f., *Stimpson* (A), (B). Bay of Fundy, five to eighty f., *Verrill* (F). Passamaquoddy Bay, L'Etang harbour.

32.—NATICA CLAUSA.—Brod. and Sowerby.

Eastport, *Stimpson* (A). Grand Manan, twenty-five f., *Stimpson* (A), (B). Bay of Fundy, "not uncommon," six to one hundred and nine f., *Verrill* (F).

33.—LUNATIA NANA.—(Möll), Sars.

Seal Cove, Grand Manan, *Verrill* (K), (N). Eastport, *Verrill* (K).

34.—LUNATIA GRŒNLANDICA.—(Möll.), Stimpson.

NATICA GRŒNLANDICA. Beck (B).

Grand Manan, very deep water, *Stimpson* (A), (B).

35.—LUNATIA TRISERIATA.—Say.

NATICA TRISERIATA. Say (B).

N. HEROS VAR. TRISERIATA. Gould (F).

Grand Manan, littoral zone and ten f., *Stimpson* (B). Bay of Fundy, one to forty f., *Verrill* (F). Northumberland Straits, *Whiteaves* (I), (H). Passamaquoddy Bay, *Ganong* (O). Abundant in sand everywhere on the southern coast.

The relations of this species to the following (*L. Heros*) have been much debated. At first considered the young of the latter or again a distinct species, it is now generally regarded as a variety of *L. Heros.*

36.—LUNATIA HEROS.—(Say), Stimpson. (Round whelk sea-snail).

NATICA HEROS. Say (B).

Grand Manan, *Stimpson* (B). Near Dalhousie, *Bell* (C). Eastport, *Gould* (E). Bay of Fundy, common, low-water mark to forty f., *Verrill* (F). Shediac, *Whiteaves* (I). Passamaquoddy Bay, *Ganong* (O). L'Etang and Bliss harbours, St. Croix River, and in fact abundant almost everywhere on the Charlotte County coast where there is sand.

The shells of this species, together with its saucer-shaped egg-masses, are among the most common objects of the sea-shore. The dead shells are washed up by the waves, and the broken and bleached shells so often found above high-water mark, are carried up while alive by the crows.

37.—LAMELLARIA PERSPICUA.—(Lin.), Stimpson.

West Isles, twenty-five f., rocky, *Stimpson* (A). Grand Manan, coralline zone, *Stimpson* (B).

38.—VELUTINA ZONATA.—Gould.

Eastport, off Friars' Head, fourteen f., *Stimpson* (A). Grand Manan, laminarian zone, *Stimpson* (B). Eastport, twenty f., *Gould* (E). L'Etang harbour.

39.—VELUTINA HALIOTOIDEA.—(Fabr.), Stimpson.

VELUTINA HALIOTOIDES. Möll, (A), (B).

Eastport, twenty f., rocky, *Stimpson,* (A). Grand Manan, *Stimpson* (B). Eastport, twenty f., *Gould* (E).

40.—MENESTHO ALBULA.—(Fabr.), Möller.

West Isles, near Eastport, ten f., gravel, *Stimpson* (A). Grand Manan, laminarian and coralline zones, *Stimpson* (B). Bay of Fundy, *Verrill* (F), page 660.

41.—TURBONILLA NIVEA.—Stimpson.

CHEMNITZIA NIVEA. Stimpson (A), (B).

Grand Manan, frequent in thirty-five f., *Stimpson*, (A), (B).

42.—TURBONILLA INTERRUPTA.—(Totten), Stimpson.

Shediac, *Whiteaves* (H), (I). Northumberland Straits, *Whiteaves* (I).

43.—ODOSTOMIA TRIFIDA.—(Totten), Gould.

Point duChene, *Whiteaves* (H). Shediac, *Whiteaves* (I).

44.—BITTIUM NIGRUM.—(Totten), Stimpson.

Shediac, *Whiteaves* (I). Point duChene, *Whiteaves* (H).

45.—APORRHAIS OCCIDENTALIS.—Beck.

Off Campobello, 50 f., mud, *Stimpson* (A). Grand Manan, thirty-five f., *Stimpson* (B). Eastport, twenty f., Bay of Fundy, *Gould* (E). Passamaquoddy Bay.

46.—TURRITELLA ACICULA.—Stimpson.

Grand Manan, low-water mark to four and forty f., *Stimpson* (A), (B).

47.—TURRITELLA COSTULATA.—Mighels and Adams.

ACIRSA COSTULATA. (M).

Eastport, thirty f., rocky, *Stimpson* (A). Grand Manan, in deep water, rare, *Stimpson* (B). Bay of Fundy, *Verrill* (M), (N).

48.—TURRITELLA RETICULATA.—Mighels and Adams.

Bay Chaleur, "from the stomachs of cod-fishes," *Mighels and Adams*, (Boston Journal Natural History, IV. 50). *Gould* (E).

49.—TURRITELLA EROSA.—Couthouy.

Off Campobello, fifty f., mud, *Stimpson*, (A). Grand Manan, forty f., *Stimpson* (B). Eastport, *Gould* (E).

50.—SCALRIA GRŒNLANDICA.—(Perry), Sowerby.

Eastport, ten f., sand; off Seal harbour, fifty f., *Stimpson* (A). *Gould* (E). Grand Manan, ten to sixty f., *Stimpson* (A), (B). Bay of Fundy, common, ten to one hundred and nine f., *Verrill* (F).

51.—ACLIS STRIATA.—Verrill.

Bay of Fundy near Eastport, *Verrill* (K), (N).

52.—LITTORINA PALLIATA.—(Say.), Gould.

LITTORINA LITTORALIS. F. et H. (B).

Reported by all observers as abundant upon the southern coast. Dalhousie, *Bell* (C).

**This species exists all around the North Atlantic Ocean. It is indigenous to this country and is often called the "native periwinkle."**

53.—LITTORINA LITOREA.-(Linn.), Menke., (Periwinkle).

Abundant in the waters of the Charlotte County coast. Northumberland Straits, *Sir Wm. Dawson.* South Shore of Prince Edward Island, *J. F. Whiteaves* (H) (I).

This species is an important food-mollusc in England. It has been a disputed question as to whether it is indigenous to our shores or has been recently introduced from Europe. In an article by the writer in the " American Naturalist " for November, 1886, the evidence upon both sides is summed up and the conclusion arrived at that it is introduced, not indigenous. It was not reported by Stimpson (A), (B), nor by Verrill until very recently (K). It is not mentioned in any early lists of New England shells, has not been found in any Indian shell-heap nor in the post-pliocene deposits of Canada, and has not been found in Greenland or Labrador, in all of which situations, *L. palliata,* which is undoubtedly indigenous and which has almost the same habitat as *L. litorea,* does occur. There is absolutely no evidence to show that the shell existed in America before the advent of Europeans, and though the evidence tending to show that it did not exist here is necessarily of a negative character, it very strongly points to the latter conclusion. It is but right to add that Sir Wm. Dawson considers the shell indigenous to America.

54.—LITTORINA RUDIS.—(Maton), Gould.

Reported by all observers as abundant upon the southern coast.

Occurs with the following, chiefly upon bare rocks and the piles of wharves, while the two previous forms prefer the sea-weed and rocks covered by the latter.

55.—LITTORINA TENEBROSA.—(Montagu), Gould.

With the last.

The form of this and the last species grade into one another. This is probably but a variety of the last.

56.—LACUNA NERITOIDEA.—Gould.

Grand Manan, *Verrill* (F).

57.—LACUNA VINCTA.—(Turton), Gould.

Grand Manan, *Stimpson* (B). Eastport, *Gould* (E). Very abundant in Bay of Fundy, *Verrill* (F).

58.—RISSOA CARINATA.—(Mighels and Adams), Stimpson.

RISSOA PELAGICCA. Stimpson (A), (B).

Grand Manan, coralline zone, *Stimpson* (A), (B).

It is altogether probable that this is but a variety of the last species.

The clam is the most abundant and most easily obtained of all our food molluscs. It is found in the mud of every cove and inlet on the Charlotte County coast, where it is an important article of food to the fishermen. The supply is almost inexhaustible and not utilized to one-tenth the extent of which it is capable.

Some one or more species of Teredo are unfortunately abundant on both our north and south coasts, but their affinities have not been worked out.

59.—RISSOA MIGHELSI.—Stimpson.

(RISSOA EXARATA. Stimpson (F) ).

Grand Manan, twenty-five f., *Stimpson* (B). Bay of Fundy, four to twenty f., *Verrill* (F).

60.—RISSOA ACULEUS.—(Gould), Stimpson.

Grand Manan, littoral zone, rare, *Stimpson* (B). Bay of Fundy, common, *Verrill* (F).

61.—RISSOA MINUTA.—(Totten), Stimpson.

PALUDINELLA MINUTA. (I).

LITTORINELLA MINUTA. Stimpson (F).

Bay of Fundy, *Verrill* (F). Shediac, *Whiteaves* (I).

62.—RISSOELLA? EBURNEA.—Stimpson.

RISSOA EBURNEA. Stimpson (B).

Grand Manan, twenty-five f., *Stimpson* (B).

63.—SKENEA PLANORBIS.—(O. Fabr.), Forbes and Hanley.

Bay of Fundy, very common, *Verrill* (F).

64.—TROCHUS OCCIDENTALIS.—Mighels and Adams.

Grand Manan, twenty-five to forty f., *Stimpson* (A), (B).

65.—MARGARITA VARICOSA.—Mighels and Adams).

Bay Chaleur, "from the stomach of a cod-fish," *Mighels and Adams*, (Boston Journal Natural History, Vol. IV., page 46), *Gould* (E).

66.—MARGARITA ACUMINATA.—Mighels and Adams.

Grand Manan, forty f., *Stimpson* (B).

67.—MARGARITA OBSCURA.—(Couth.), Gould.

Eastport, six f., mud, *Stimpson* (A). Grand Manan, laminarian zone, *Stimpson* (A) (B). Common in Bay of Fundy from low water mark to one hundred f., *Verrill* (F).

68.—MACHŒROPLAX OBSCURA *var* BELLA.—(Verkr).

"This appears to be only a highly sculptured variety of M. OBSCURA," *Verrill* (N).

"The predominant form at Eastport, Me., and in the Bay of Fundy . . . . . in ten to forty f., *Verrill*" (N).

69.—MARGARITA ARGENTATA.—Gould.

Grand Manan, four f., *Stimpson* (A) (B). *Gould* (E).

70.—MARGARITA HELICINA,—(Fabr.). Stimpson.

Grand Manan, on marine plants above low water mark, *Stimpson* (B). L'Etang harbour.

71.—MARGARITA UNDULATA.—Sowerby.

Grand Manan, in shallow water, *Stimpson* (A), (B). Eastport, *Gould* (E). L'Etang harbour and Passamaquoddy Bay.

72.—MARGARITA CINEREA.—(Couth.), Gould.

West Isles, ten f., gravel, *Stimpson* (A). Grand Manan, deep water, *Stimpson* (A), (B). *Gould* (E), L'Etang harbour and Passamaquoddy Bay.

73.—ADEORBIS COSTULATA.—(Möller), Stimpson.

Grand Manan, thirty and four f., *Stimpson* (A), (B). *Gould* (E).

74.—CEMORIA NOACHINA.—(Lin.), Gould.

DIADORA NOACHINA. Gray (B).

Eastport, twenty-five f., rocky, *Stimpson* (A). Grand Manan, low-water mark and deep water, *Stimpson* (B).

75.—CRUCIBULUM STRIATUM.—(Lay), Stimpson.

CALYPTRAEA STRIATA. Say, (B).

Eastport, four f., *Stimpson* (A). Grand Manan, *Stimpson* (B). Bay of Fundy, common, low-water mark to thirty f., *Verrill* (F). Very abundant in seven to ten f. in L'Etang harbour.

76.—CREPIDULA PLANA.—Say.

CREPIDULA UNGUIFORMIS. Lam., (I).

Caraquette, *Bell* (C). Bay Chaleur, *Whiteaves* (D). Shediac, *Whiteaves* (I). Not found on the southern coast.

77.—CREPIDULA FORNICATA.—(Lin.), Lamarck. (Bonnet limpet).

Dalhousie, Caraquette, (very abundant), *Bell* (C). Bay Chaleur, *Whiteaves* (D). Shediac, *Whiteaves* (I). Northumberland Straits and along the coast to Caraquette Bay, *Whiteaves* (H). Not found on the southern coast.

78.—LEPETA CAECA.—Müller.

PILIDIUM CAECUM. (B).

Grand Manan, not unfrequent in littoral zone, *Stimpson* (B).

79.—TECTURA ALVEUS.—(Conrad), Stimpson.

LOTTIA ALVEUS. Conrad (I).

ACMAEA ALVEUS. Con. (H).

Point du Chene, *Whiteaves* (H). Shediac, *Whiteaves* (I). Not found on the southern coast.

80.—TECTURA TESTUDINALIS. — (Müller), (Gould), (Limpet).

Grand Manan, *Stimpson* (B). Bay Chaleur, *Bell* (C). Passamaquoddy Bay, *Ganong* (O). Abundant on the rocks everywhere on the southern coast.

81.—ENTALIS STRIOLATA. Stimpson.

DENTALIUM STRIOLATUM. St. (B).

Eastport, ten f., mud, *Stimpson* (A). Grand Manan, coralline zone, *Stimpson* (A), (B). Passamaquoddy Bay, *Ganong* (O). Abundant almost everywhere on muddy bottoms on southern coast.

82.—CHITON MENDICARIUS. Mighels and Adams.

Grand Manan, "a few fine specimens of this rare species," thirty-five f., *Stimpson* (B). *Gould* (E).

83.—CHITON ALBUS.—Montagu.

Eastport, at low water, *Stimpson* (A), *Gould* (E). Grand Manan, low-water mark to four f., *Stimpson* (B). Bay of Fundy, abundant, low-water mark to eighty f., *Verrill* (F). Pendleton's Island, *Ganong* (O). Abundant at latter point on under side of stones in tide pools.

84.—CHITON MARMOREUS.—O. Fabricius.

Grand Manan, very abundant on rocky bottoms just below low water mark, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, low water mark to forty f., common, *Verrill* (F).

85.—CHITON RUBER.—Lowe.

TRACHYDERMON RUBER.—Carpenter (F).

Grand Manan, with the last, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, low water mark to forty f., common, *Verrill* (F). Pendleton's Id., *Ganong* (O).

**86.—LEPTOCHITON CANCELLATUS,—(Sby.), Gray; H. and A. Adams.**

**Bay of Fundy, *Verrill* (N).**

87.—ALDERIA HARVARDIENSIS.—**(Agassiz), Gould.**

CANTHOPSIS HARVARDIENSIS.—**Agass.** (B).

Grand Manan, common in sheltered, muddy bays, *Stimpson* (B). *Gould* (E).

88.—ÆOLIS DESPECTA.—Johnston.

TERGIPES DESPECTUS.—Adams (F).

Bay of Fundy, Eastport harbour, *Verrill* (F).

89.—AEOLIS DIVERSA.—(Couthouy), Stimpson.

EOLIS DIVERSA.—Couth. (B).

Grand Manan, four f., *Stimpson* (B). *Gould* (E).

90.—ÆOLIS PURPUREA.—Stimpson.

EOLIS PURPUREA.—St. (B).

Grand Manan, under stones at low water, *Stimpson* (B). *Gould* (E).

91.—ÆOLIS STELLATA.—Stimpson.

EOLIS STELLATA.—St. (B).

Grand Manan. under stones at low-water mark, *Stimpson* (B). *Gould* (E).

92.—CORYPHELLA MANANENSIS.—(Stimp.), Verrill and Emerton.

EOLIS MANANENSIS.—St. (B).

Grand Manan, thirty-five f., on gravel, *Stimpson* (B). At low-water mark,—Eastport, and Grand Manan, *Verrill* (N).

This species is undoubtedly the one referred in Gould's Invertebrata of Massachusetts to AEOLIS RUFIBRANCHIALIS.

93.—AEOLIS PAPILLOSA.—(Lin.), Loven.

EOLIS FARINACEA.—Gould, Ms. (B).

Grand Manan, on rocks above low-water mark, *Stimpson* (B). Very common in Bay of Fundy from above low-water mark to twenty f., *Verrill* (F).

94.—DOTO CORONATA.—(Gmêlin), Loven.

Grand Manan, fifteen f., on rocks, *Stimpson* (B). *Gould* (E). Common in Bay of Fundy, low-water mark to fifteen f., *Verrill* (F).

95.—DENDRONOTUS ARBORESCENS.—(Müller), Alder and Hancock.

Grand Manan, low water and laminarian zone, *Stimpson* (B). *Gould* (E). Very common in Bay of Fundy, above low-water mark to sixty f., *Verrill* (F).

96.—ANCULA SULPHUREA.—Stimpson.

Grand Manan, under stones at low water and in laminarian zone, *Stimpson* (B). *Gould* (E).

97.—DORIS PLANULATA.—Stimpson.

Grand Manan, *Stimpson* (B). "Found at Grand Manan, and on stones at low water, Passamaquoddy Bay, in July," *Gould* (E).

98.—DORIS PALLIDA.—Agassiz.

ONCHIDORIS PALLIDA. Verrill (F).

Grand Manan, twenty-five f., gravel, *Stimpson* (B). Bay of Fundy, Eastport harbour, not uncommon, low-water mark to thirty f., *Verrill* (F).

99.—POLYCERA LESSONII.—D'Orbigny.

Common in Bay of Fundy, low-water mark to twenty f., *Verrill* (F).

100.—BULLA SOLITARIA.—Say.

HAMINAEA SOLITARIA. Say (I).

Shediac, *Whiteaves* (I). Point du Chene, *Whiteaves* (I).

101.—CYLICHNA ALBA.—(Lovén), Stimpson.

BULLA TRITICEA. Couth. (B).

Grand Manan, common, *Stimpson* (B). *Gould* (E). Bay of Fundy, *Verrill* (F). Passamaquoddy Bay, ten f., *Ganong* (O).

102.—UTRICULUS PERTENUIS.—(Mighels), Stimpson.

BULLA PERTENUIS. Migh. (B).

CYLICHNA PERTENNIS. Migh. (I).

Grand Manan, ten f., sand, *Stimpson* (B). *Gould* (E). Shediac, *Whiteaves* (I).

103.—DIAPHANA DEBILIS.—(Gould), Stimpson.

BULLA DEBILIS. Gould (A), (B).

AMPHISPHYRA DEBILIS. Verrill (F).

Eastport, *Stimpson* (A). Grand Manan, six f., sand, *Stimpson* (A), (B). *Gould* (E). Bay of Fundy, not uncommon, six to fifty f., *Verrill* (F).

104.—DIAPHANA HIEMALIS.—(Couthouy), Stimpson.

BULLA HIEMALIS.—Couth. (B).

Grand Manan, forty f., *Stimpson* (B). *Gould* (E).

105.—PHILINE LINEOLATA.—(Couthouy), Stimpson.

Eastport, *Stimpson* (A). Grand Manan, common in shallows, *Stimpson* (B). *Gould* (E).

## Class LAMELLIBRANCHIATA.*

106.—ANOMIA ACULEATA.—Gmélin.

Grand Manan, rather common in deep water, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, very common, low water to eighty f., *Verrill* (F). Passamaquoddy Bay, *Ganong* (O).

106*a*—ANOMIA EPHIPPIUM.—Lin.

Grand Manan, roots of Laminaria, *Stimpson* (B). Eastport, *Gould* (E). Passamaquoddy Bay, *Ganong* (O).

But Verrill (F., page 697) says of it,—"not observed . . . in the Bay of Fundy." "The specimens from Eastport, Maine, referred to *A. Ephippium* by Gould, were, undoubtedly, the smooth or squamous variety of the following (*i. e.*, No. 106 of this list) species." It hence stands doubtfully in our fauna.

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* In Binney's Gould, between this class (called in that work CONCHIFERA) and the GASTEROPODA is placed the class BRACHIOPODA. The Brachiopods, however, are now known not to be molluscs, but to belong to a separate group, the Molluscoidea. The class is, consequently, omitted from the present list. The only species found upon our coast is TERETRATULINA SEPTENTRIONALIS, Couthouy. It occurs at Grand Manan, *Stimpson* (B). Eastport, *Gould* (E). Passamaquoddy Bay, *Ganong* (O), and at Beaver harbour, (Bulletin Natural History Society of New Brunswick, No. V., page 35).

107.—OSTREA VIRGINIANA.—Lister. (Oyster).

Including OSTREA BOREALIS.—Lamarck.

"Caraquette to Baie Verte," (*Perley*), *Whiteaves* (H) (I). Bay Chaleur, *Whiteaves* (D). Shediac, *Whiteaves* (H) (I), Cocagne, *Nicholas Denys*, 1672. Tabusintac, Shippegan harbour, Saint Simon's Inlet, Buctouche, Richibucto, Burnt Church, "and other places," *M. H. Perley*, Report on the Sea and River fisheries of N. B., 1882.

It is now generally considered that all of our oysters belong to a single species, and they are so treated in the present paper.

This important economic mollusc is rapidly growing less abundant upon our coast. This may be due in part to natural causes, the presentation of which would be out of place in the present connection. But it is certainly largely due to the reckless and improvident method of fishing the oyster-beds. Mr. J. F. Whiteaves (H), (I), has called attention to the present state and needs of oyster-culture in New Brunswick, and to his papers those interested may turn for further information.

108.—PECTEN ISLANDICUS. (Müller), Chemnitz.

Eastport, *Stimpson* (A). *Gould* (E). Grand Manan, twenty-five to forty (f.), shelly, *Stimpson* (B). Common in Bay of Fundy, low-water mark to one hundred f., *Verrill* (F). L'Etang harbour.

This species is seldom or never used for food. It is much smaller and less abundant than the following.

109.—PECTEN TENUICOSTATUS.—Mighels and Adams. (Scallop).

PECTEN MAGELLANICUS. Lam., (B).

Grand Manan, ten to thirty f., rather rare, *Stimpson* (B). Eastport, *Gould* (E). *Verrill* (K). Common in Passamaquoddy Bay and Bay of Fundy, one to one hundred and nine f., *Verrill* (F). Northumberland Straits, *Whiteaves* (I). L'Etang and Chamcook harbours, *Ganong* (O). Mace's Bay. (Perley's Report on Fisheries of New Brunswick, 1852).

It would seem from the testimony of fishermen and others that this food-mollusc is not as abundant on our coasts as formerly. Mr. E. Ingersoll, in an article on "The Scallop and its Fishery," in the "American Naturalist" for Dec., 1886, says: "The great *Pecten tenuicostatus* of the coast of Maine and the Bay of Fundy was formerly highly valued by the people of that region, but now is too scarce to appear on the tables of even 'the rich' except at rare intervals." Its scarcity is exaggerated for New Brunswick waters at least, for it still exists in considerable numbers in L'Etang harbour, Mace's Bay, and at a few other points. No doubt wise regulations as to its fishery would make it of considerable economic importance.

110.—CRENELLA GLANDULA.—(Totten), H. and A. Adams.

MYTILUS DECUSSATUS. Mont. (B).

CRENELLA DECUSSATA. (Montagu), Macgillivray (N).

Eastport, four to forty f., sandy mud, *Stimpson* (A). *Gould* (E). Grand Manan, forty f., *Stimpson* (B); three to ten f., *Verrill* (N). Common in Bay of Fundy, three to sixty f., *Verrill*, (F). Bradelle Bank, (Gulf of St. Lawrence), *Whiteaves* (I). Passamaquoddy Bay, *Ganong* (O).

111.—MODIOLARIA CORRUGATA.—(Stimpson), Mörch.

MYTILUS CORRUGATUS. St. (B).

Eastport, forty f., sandy mud, *Stimpson* (A). *Gould* (E). Grand Manan, thirty-five f., gravel, *Stimpson* (B). Bay of Fundy, ten to one hundred f., frequent, *Verrill* (F).

112.—MODIOLARIA DISCORS.—(Lin.), Lovén.

MYTILUS DISCORS. Lin., (B).

MYTILUS LEVIGATUS. St. (B).

CRENELLA LAEVIGATA. (I).

Eastport, low water to twenty f., gravel, *Stimpson* (A), *Gould* (E). Grand Manan, low-water mark to forty f., *Stimpson* (B). Bay of Fundy, very common, low water to one hundred f., *Verrill* (F). Bradelle Bank, *Whiteaves* (I).

113.—MODIOLARIA NIGRA.—(Gray), Loven.

MYTILUS DISCREPANS.—Mont. (B).

Eastport, five f., *Stimpson* (A). Grand Manan, common, *Stimpson* (A) (B). Common in Bay of Fundy, low water to sixty f., *Verrill* (F). Bradelle Bank, *Whiteaves* (I). Passamaquoddy Bay, *Ganong* (O). Bliss and L'Etang harbours.

114.—MODIOLA MODIOLUS.—Lin. (Horse-mussel).

MYTILUS MODIOLUS.—L. (B).

Grand Manan, on the shores, *Stimpson* (B). Shediac, *Whiteaves* (I). Pendleton's Id., Passamaquoddy Bay, *Ganong* (O).

115.—MYTILUS EDULIS.—Lin., (Edible mussel).

Grand Manan, very abundant, Stimpson (B). Bay Chaleur, *Bell* (C). Eastport, *Gould* (E). Bay of Fundy, littoral zone to fifty f., *Verrill* (F). Shediac, *Whiteaves* (I). Passamaquoddy Bay, *Ganong* (O). L'Etang harbour, and everywhere in great abundance along the southern coast.

*Var.* PELLUCIDUS.—Pennant.

Occurs sporadically with *M. edulis,* in the same situations.

This species is exceedingly abundant on our southern coast, where it occurs in immense beds between tide-marks. It is extensively used for food in Europe, but is altogether unutilized among us for any such purpose.

116.—LEDA TENUISULCATA.—(Couth), Stimpson.

Eastport, six f., *Stimpson* (A). Grand Manan, common on mud, *Stimpson* (B). *Gould* (E). Common in Bay of Fundy, six to eighty f., *Verrill* (F). Passamaquoddy Bay, *Ganong* (O).

117.—YOLDIA MYALIS.—(Couth.) Gould.

LEDA MYALIS.—St. (B).

Eastport, *Stimpson* (A). *Gould* (E). Grand Manan, twenty f., mud, *Stimpson* (B).

118.—YOLDIA SAPOTILLA.—(Gould), Stimpson.

LEDA SAPOTILLA.—(B).

Eastport, ten f., mud, *Stimpson* (A). *Gould* (E). Grand Manan, ten f., *Stimpson* (B). Common in Bay of Fundy, four to one hundred f., mud, *Verrill* (F). Northumberland Straits, *Whiteaves* (H), (I).

119.—YOLDIA THRACIÆFORMIS.—(Storer), Mörch.

LEDA THRACIÆFORMIS.—St. (B).

St. Andrews Bay, ten f. Head harbour, Campobello, forty f., *Stimpson* (A). Grand Manan, twenty-five f., mud, *Stimpson* (B). *Gould* (E). Bay of Fundy, not uncommon, ten to one hundred f., *Verrill* (F).

120.—YOLDIA OBESA.—(Stimpson), Gould.

Bay of Fundy, forty to one hundred f., rare, *Verrill* (F).

121.—YOLDIA LIMATULA.—(Say), Adams.

LEDA LIMATULA. St. (B).

Eastport, six f., mud, *Stimpson* (A). *Gould* (E). Grand Manan, six f., mud, *Stimpson* (B). Bay of Fundy, not common, four to thirty f., *Verrill* (F). Northumberland Straits, *Whiteaves* (H), (I).

122.—NUCULA DELPHINODONTA.—Mighels.

Grand Manan, twenty-five f., mud, *Stimpson* (B). *Gould* (E). Bay of Fundy and Eastport harbour, ten to one hundred f., mud, common, *Verrill* (F). Northumberland Straits, *Whiteaves* (I).

123.—NUCULA PROXIMA.—Say.

Grand Manan, four f., sand, *Stimpson* (B). *Gould* (E). Bay of Fundy, common, four to eighty, f., *Verrill* (F).

124.—NUCULA TENUIS.—(Montagu), Turton.

Grand Manan, four to forty f., mud, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, common, ten to one hundred f., *Verrill* (F).

125.—ARCA PECTUNCULOIDES.

Bay of Fundy, off Grand Manan, *Verrill* (G).

126.—ARCA PECTUNCULOIDES.—Scacchi.

*Var.* FRIELEI, (Jeffreys), Verrill.

Bay of Fundy, one hundred and eight f., *Verrill* (N).

127.—ARCA GLACIALIS.—Gray.

Bay of Fundy, *Verrill* (K).

128.—CYCLOCARDIA NOVANGLIAE.—Morse.

Bay of Fundy, not uncommon, three to forty f., *Verrill* (F).

129.—CARDITA BOREALIS.—Conrad.

CYCLOCARDIA BOREALIS. Conrad (F).

Eastport, three f., mud, *Stimpson* (A). *Gould* (E). Grand Manan, common, *Stimpson* (B). Bay of Fundy, very common, three to eighty f., *Verrill* (F). Passamaquoddy Bay, *Ganong* (O).

130.—CARDIUM PINNULATUM.—Conrad.

Grand Manan, four f., sand, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, very common, two to eighty f., *Verrill* (F). Northumberland Straits, *Whiteaves* (I). Abundant in L'Etang harbour.

131.—CARDIUM ISLANDICUM.—Lin.

Eastport, six to sixty f., *Stimpson* (A). *Gould* (E). Grand Manan, twenty to forty f., mud, *Stimpson* (B).

132.—GEMMA GEMMA.—(Totten), Chemn.

TOTTENIA GEMMA.—Perkins (F).

Grand Manan, *Verrill* (F). Shediac, *Whiteaves* (I)

133.—VENUS MERCENARIA.—Lin. (Hard clam).

MERCENARIA VIOLACEA.—Schum. (I).

Caraquette, *Bell* (C). Bay Chaleur, *Whiteaves* (D). Shediac, *Whiteaves* (I). *Verrill* (F).

134.—CYTHEREA CONVEXA.—Say.

CALLISTA CONVEXA.—Say (F) (I).

Eastport, Maine, rare, *Verrill* (F). Shediac, *Whiteaves* (I). Northumberland Straits, *Whiteaves* (H) (I).

135.—CYPRINA ISLANDICA.—(Lin.), Lamarck.

Grand Manan, rarely found, *Stimpson* (B). Bay of Fundy, six to ninety f., *Verrill* (F). Northumberland Straits, *Whiteaves* (H) (I). Passamaquoddy Bay, *Ganong* (O).

136.—ASTARTE QUADRANS.—Gould.

Grand Manan, rare, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, six to forty f., *Verrill* (F).

137.—ASTARTE SULCATA.—(Da Costa), Flemming.

ASTARTE UNDATA.—Gould (F), (H), (I).

Eastport, four to sixty f., mud, *Stimpson* (A), *Gould* (E). Grand Manan, deep water, on mud, common, *Stimpson* (A), (B). Bay of Fundy, very common, five to one hundred f., *Verrill* (F). Northumberland Straits, *Whiteaves* (H), (I). Passamaquoddy Bay, *Ganong* (O).

138.—ASTARTE CASTANEA.—Say.

Bay of Fundy, five to twenty f., not common, *Verrill* (F).

139.—ASTARTE LENS.—(Dwarf var.)

Centre of Bay of Fundy, *Verrill* (Am. J., Sci. iii., V. 98) (K).

140.—CRYPTODON GOULDII.—(Phillippi), Adams.

THYASIRA GOULDII.—St. (B).

Eastport, five f., *Stimpson* (A), *Gould* (E). Grand Manan, four and twenty-five f., *Stimpson* (B). Bay of Fundy, five to sixty f., mud and sand, common, *Verrill* (F).

141.—TELLINA TENERA.—Say.

ANGULUS TENER.—Verrill (F).

Bay of Fundy, *Verrill* (F). Off Douglastown, *Whiteaves* (Can. Nat. vol. iv., 1869, p. 270).

142.—MACOMA PROXIMA.—(Gray), Gould.

TELLINA PROXIMA.—Brown (B).

MACOMA SABULOSA.—Mörch (F).

Eastport, *Stimpson* (A), *Gould* (E). Grand Manan, low-water mark, to four f., *Stimpson* (B). Bay of Fundy, four to eighty f., *Verrill* (F).

143.—MACOMA FUSCA.—(Say), Gould.

TEELINA GRŒNLANDICA.—(Rep. Geol. Surv., 1858, Bell).

TEELINA FUSCA.—Phil. (B).

Grand Manan, littoral zone, *Stimpson* (B). Bay Chaleur, *Bell*, (Report Can. Geol. Survey, 1858). Eastport, rare, *Gould* (E).

144.—PETRICOLA PHOLADIFORMIS.—Lamarck.

Shediac, *Whiteaves* (I). Northumberland Straits, *Whiteaves* (H), (I).

145.—PETRICOLA DACTYLUS.—Say.

PETRICOLA PHOLADIFORMIS *Var.* DACTYTUS (H), (I).

Shediac, *Whiteaves*, (I). Northumberland Straits, *Whiteaves* (H.), (I).

146.—SAXICAVA ARCTICA.—(Lin). Deshayes.

Grand Manan, occasionally in deep water, *Stimpson* (B).

147.—SAXICAVA RUGOSA.—(Pennant). Lamarck.

Grand Manan, large and common at low water, small in deep water, *Stimpson* (B). Passamaquoddy Bay, *Ganong* (O).

It is altogether probable that this is but a variety of the last species.

148.—KELLIA PLANULATA.—Stimpson.

Eastport, Maine, eight to fifteen f., Bay of Fundy, *Verrill* (F).

149.—MACTRA LATERALIS.—Say.

Ten miles north of Shediac, *Whiteaves* (H). Northumberland Straits, *Whiteaves* (I).

150.—MACTRA SOLIDISSIMA.—Chemnitz, (Hen clam).

Eastport, *Stimpson* (A). Grand Manan, in sand at low water, *Stimpson* (A), (B). Bay of Fundy, low-water mark to ten f., sandy, *Verrill* (F). Point du Chene, *Whiteaves* (H). Shediac, *Whiteaves* (I). Very large and abundant at Hospital Island, Passamaquoddy Bay.

151.—MACTRA OVALIS.—Gould.

MACTRA PONDEROSA.—Phil. (A), (B.

Eastport, *Stimpson* (A). *Gould* (E). Grand Manan, with *M. solidissima*, *Stimpson* (B). *Verrill* (G).

152.—THRACIA TRUNCATA.—Mighels and Adams.

Grand Manan, ten f., coarse sand, *Stimpson* (B). Bay of Fundy, *Verrill* (F).

153.—THRACIA MYOPSIS.—Beck.

Grand Manan, *Stimpson* (B). *Gould* (E).

154.—THRACIA CONRADI.—Couthouy.

Grand Manan, rare, *Stimpson* (B). *Gould* (E). Eastport, six f., *Verrill* (F). Point du Chene, *Whiteaves* (H). Shediac, fine and frequent, *Whiteaves* (I). Bliss harbour, (misplaced in Passamaquoddy Bay), *Ganong* (O).

155.—COCHLODESMA LEANUM.—(Conrad), Couthouy.

Eastport, Maine, rare, *Verrill* (F). Near Douglastown, *Whiteaves* (Can. Nat., Vol. IV., 1869, page 270).

156.—ANATINA PAPYRACEA.—Say.

PERIPLOMA PAPYRACEA.—*Verrill* (F).

Eastport, *Gould* (E). Bay of Fundy, not uncommon, ten to one hundred f., *Verrill* (F).

157.—LYONSIA HYALINA.—Conrad.

Grand Manan, ten f., sand, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, common, low-water mark, to thirty f., *Verrill* (F).

158.—PANDORA TRILINEATA.—Say.

CLIDIOPHORA TRILINEATA.—Carpenter (F).

Eastport, five f., mud, *Stimpson* (A), *Gould* (E). Grand Manan, five f., mud, *Stimpson* (B). Bay of Fundy, low-water mark, to 30 f., *Verrill* (F). Shediac, *Whiteaves* (I). Northumberland Straits, *Whiteaves* (H), (I).

159.—**NEAERA PELLUCIDA.**—Stimpson.

NEAERA OBESA.—Lovén (N).

Grand Manan, 40 f., mud, *Stimpson* (B), *Gould* (E). Bay of Fundy, *Verrill* (M), (N).

160.—NEAERA GLACIALIS.—G. O. Lars.

Bay of Fundy, *Verrill* (K), (N).

161.—**MYA TRUNCATA.**—Lin.

Eastport, *Stimpson* (A), *Gould* (E). Grand Manan, low-water mark, *Stimpson* (B). Shediac, *Whiteaves* (I).

162.—**MYA ARENARIA.**—Lin. (Clam).

Grand Manan, common in the coves, *Stimpson* (B). Bay Chaleur, *Bell* (C). Bay of Fundy, half tide mark, to forty f., those dredged being young, *Verrill* (F). Shediac, *Whiteaves* (I). Passamaquoddy Bay, very abundant, *Ganong* (O).

The clam is the most abundant and most easily obtained of all our food molluscs. It is found in the mud of every cove and inlet on the Charlotte County coast, where it is an important article of food to the fishermen. The supply is almost inexhaustible and not utilized to one tenth the extent of which it is capable.

163.—**PANOPAEA ARCTICA.**—(Lamarck), Gould.

PANOPAEA NORVEGICA.—Lovén (B).

Grand Manan, forty f., (dead), *Stimpson* (B), *Gould* (E).

164.—SOLEN ENSIS.—Lin. (Razor fish, Razor clam).

ENSTATELLA AMERICANA. Verrill (F).

SOLEN ENSIS, *Var.* AMERICANA. (I).

Grand Manan, at low water, in sand, rare, *Stimpson* (B). Eastport, *Gould* (E). Bay of Fundy, low-water mark to twenty f., sandy, *Verrill* (F). Shediac, *Whiteaves* (I). Hospital Island, Passamaquoddy Bay, *Ganong* (O).

165.—ZIRFAEA CRISPATA.—(Lin.), Adams.

PHOLAS CRISPATA. L. (A), (B).

ZIRPHAEA CRISPATA. Adams (F).

Eastport, *Stimpson* (A). Grand Manan, very rare, *Stimpson* (B). Bay of Fundy, eight to seventy f., in hard clay, *Verrill* (F).

166.—TEREDO DILATA.—Stimpson.

"Principal Dawson informs me that great damages have already been done to the woodwork of wharves and harbours in Nova Scotia and New Brunswick by this species of Teredo." *Whiteaves* (H).

167.—TEREDO NAVALIS.—Lin.?

Shediac, in a spruce log, *Whiteaves* (I).

Some one or more species of Teredo are unfortunately abundant on both our north and south coasts, but their affinities have not been worked out.

## Part III.—SUPPLEMENTARY LISTS.

*(a).* A list of species of Mollusca reported from Eastport, Maine, but not as yet from New Brunswick waters proper.

1.—BELA PINGELII.—(Möller), H. and A. Adams.

Twenty to ninety f., in small numbers, *Verrill* (K), (N).

2.—BELA DECUSSATA.—(Couth.), H. and A. Adams.

*Var* TENUICOSTATA. Verrill.

Moderate depths, *Verrill* (K), (N).

3.—LUNATIA LEVICULA.—Verrill.

Very rare, *Verrill* (K), (N).

4.—MARSENIA GLABRA.—Verrill.

Not uncommon, *Verrill* (K), (N).

5.—MARSENIA PRODITA.—(Lov.), Bergh.

*Verrill* (K), (N).

6.—MARSENIA AMPLA.—Verrill.

*Verrill* (K), (N).

7.—CINGULA CASTANEA.—(Möll), Verrill, Sars.

*Verrill* (N).

8.—EULIMELLA POLITA.—Verrill.

Twenty f., *Verrill* (N).

E. VENTRICOSA of (K).

Is probably this species.

9.—ACANTHODORIS ORNATA.—Verrill.

Low-water mark, *Verrill* (N).

10.—ACANTHODORIS CITRINA.—Verrill.

Low water mark, *Verrill* (N).

11.—ACANTHODORIS STELLATA.—Muller.

*Verrill* (Am. Jour., Sci. iii., XVII., p. 313).

12.—ADALARIA PROXIMA.—(Ald. and Han.), Bergh.

Low-water mark, *Verrill* (N).

13.—LAMELLIDORIS MURICATA.—(Müller), Ald. and Han.

Low-water mark, *Verrill* (N).

14.—LAMELLIDORIS DIAPHANA.—Ald. and Han.

Low-water mark, *Verrill* (N).

15.—DOTO FORMOSA.—Verrill.

Low water mark, to fifty f., *Verrill* (N).

16.—COPYPHELLA RUTILA.—Verrill.

Low water mark, *Verrill* (N).

17.—AEOLIS SALMONACEA.—(Couth.), Gould.

CORYPHELLA SALMONACEA.—(Couth.), Verrill.

Low water, to fifty f., *Verril* (K).

18.—CORYPHELLA STIMPSONI.—Verrill.

Low water mark, to fifty f, *Verrill* (N).

19.—ALEXIA MYOSTIS.—Pfeiffer.

Common, *Verrill* (F).

20.—DORIS BIFIDA.—Verrill.

Low water mark, *Verrill* (F).

21.—CERONIA ARCTATA.—Adams.

Rare, *Verill* (F).

22.—DENTALIUM DENTALE.—Lin.

Ten to twenty f., *Gould* (E).

23.—ASTARTE CREBRICOSTATA.—Forbes.

*Gould* (E).

*(b).* A list of species dredged on Orphan and Bradelle banks, Gulf of St. Lawrence, by J. F. Whiteaves (I).

These two banks lie off the entrance to Bay Chaleur. and "seem to be outliers, so to speak, inhabited by a purely arctic fauna, and surrounded almost entirely by a more southern assemblage." While geographically these banks come among the localities included in the scope of the foregoing list, zoologically they do not. The species found on them are therefore given in a separate list, those which occur upon the southern coast also being marked with an asterisk.

### From Orphan Bank.

*SAXICAVA ———.

*ZIRPHAEA CRISPATA.

AMICULA EMERSONII.—(Couth).

*MAMMA IMMACULATA.—(Totten.)

TROPHON CRATICULATUS.—(O. Fabr.)

BUCCINUM TENUE.—Gray.

NEPTUNEA SPITZBERGENSIS.—(Reeve).

TRITONOFUSUS, KROYERI.—Möll.

ASTYRIS HOLBOLLII.—Beck.

ASTARTE LACTEA.—Brod. and Sowerby.
[ASTARTE SEMISULCATA.—(Leach), Gray].

### From Bradelle Bank, (almost due south of Orphan Bank.)

ASTARTE LACTEA.—Brod. and Sowerby.
[ASTARTE SEMISULCATA.—(Leach), Gray].
ASTARTE ELLIPTICA.

ASTARTE BANKSII.

VENUS FLUCTUOSA.—Gould.
[TAPES FLUCTUOSA.—(Gould), Deshayes].

CARDUIM GRŒNLANDICUM.
[APHRODITE GRŒNLANDICA.-(Chemn.), Stimpson.]

*CRENELLA NIGRA.

[MODIOLARIA NIGRA.—Gray].

*CRENELLA LAEVIGATA.

[MODIOLARIA DISCORS.—(Lin.), Lovén].

*CRENELLA GLANDULA.

*MACOMA CALCAREA.

[MALCOMA PROXIMA.—(Gray), Gould].

*PANOPAEA NORVEGICA.

[PANOPAEA ARCTICA.—(Lam.), Gould].

CYRTODARIA SILIQUA.

[GLYCYMERIS SILIQUA.—(Chemn.). Lam].

TRITONOFUSUS LATERICEUS.—Möller.

VOLUTOPSIS NORVEGICUS.—Chemn.

(c) An additional list of species reported from the warm waters of the southern part of the Gulf of St. Lawrence, though not from New Brunswick proper—From Verrill's Report, F., and from an article on "The Shells of Prince Edward Island," by F. Bain, in the "Canadian Science Monthly" for March, 1885.

1.—BUCCINUM CINEREUM.—(Say), Gould.

UROSALPINX CINEREA. Stimpson (F).

Southern part of the Gulf of St. Lawrence, *Verrill* (F). South shore of Prince Edward Island, *F. Bain.*

2.—CREPIDULA CONVEXA.—Say.

Gulf of St. Lawrence, *Verrill* (F).

3.—UTRICULUS CANALICULATUS.—(Say), Stimpson.

South shore of Prince Edward Island, *F. Bain.*

4.—MODIOLA PLICATULA.—(Lam.), Gould.

Southern part of the Gulf of St. Lawrence, *Verrill* (F). South shore of Prince Edward Island, *F. Bain.*

5.—TELLINA POLITA?

South shore of Prince Edward Island, *F. Bain.*

6.—CUMINGIA TELLINOIDES.—Conrad.

South shore of Prince Edward Island, *F. Bain.*

# MARINE ALGÆ OF THE MARITIME PROVINCES.

G. U. HAY, PH. B.

Last year I published in the Bulletin a partial list of the marine algæ of the Bay of Fundy, amounting to thirty-three species. During the season of 1886, through the kindness of Professor Macoun, Government Botanist, and Mr. Robert Chalmers, of the Geological Survey, I was permitted to accompany the latter gentleman on a canoe trip which he made in July last, along the coasts of Caraquet and Tracadie, and around the islands of Shippegan and Miscou. Later in the season I visited Grand Manan, examining the algæ of Dark Harbor, Southern Head and other points. On proposing to Mr. MacKay, of Pictou Academy, to make this list include the marine algic flora of the Maritime Provinces, that gentleman heartily responded, and has sent me not only the result of his own observations, but a record of those plants collected on the Nova Scotia shore by Dr. Harvey and described in his " Nereis Boreali-Americana," together with some observations made by Dr. Jeans, of Prince Edward Island, and contributed to Dr. Harvey's work. To these may be added a short list published in 1879 by Professor Fowler, of Queen's University, in his addenda to the New Brunswick flora, and these are referred to in the subjoined list. A collection of marine algæ made by the late Professor C. Fred. Hartt on the shores of the Bay of Fundy has just been placed in my hands, but too late to have the results of his investigations incorporated. It is, no doubt, the earliest collection of New Brunswick algæ.

Both Mr. MacKay and myself have been too busy with regular work to give much more than a passing notice to this branch of our flora. Our aim has been to gather up the knowledge that has been attained of our marine forms of vegetation, and incorporate it in the form that follows, hoping that it will serve as a guide to the more careful study in future of these interesting plants.

I desire to express my obligation to Mr. J. E. Humphrey and Dr. W. G. Farlow of Harvard University for their determination of critical species.

St. John, March, 1887.

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## INTRODUCTORY LIST OF THE MARINE ALGÆ OF THE MARITIME PROVINCES, WITH NOTES, BY G. U. HAY, PH. B., SAINT JOHN, AND A. H. MACKAY, B. A., B. SC., F. S. SC., PRINCIPAL OF PICTOU ACADEMY, N. S.

### ORDER I.—CRYPTOPHYCEÆ.

1. Clathrocystis roseo-persicina, Cohn. On mud in brackish pond, Pictou harbour, *MacKay*; on decaying algæ along shore of Gulf of St. Lawrence, *Hay*.
2. Oscillaria subtorulosa, (Bréb). On floating balls of *Polysiphonia*, in Pictou harbour, *MacKay*.
3. Lyngbya majuscula, Harv. Pictou harbour, *MacKay*.
4. L. æstuarii, Liebm. In brackish pond, Pictou harbour, *MacKay*.

### ORDER II.—ZOOSPOREÆ.

5. Ulva lactuca. (Linn ) Le Jolis, Pictou harbour, *MacKay*.
   (*a*). Var. rigida, (Ag.) Le Jolis, and
   (*b*). Var. lactuca, Le Jolis, are common in tide pools along the southern coast of New Brunswick, *Hay*.
   (*c*). Var. latissima, Le Jolis. Richibucto River, *Fowler*. Common in brackish waters along the whole coast of New Brunswick, *Hay*.
6. U. enteromorpha, Le Jolis, also
   (*a*). Var. lanceolata, Le Jolis, and
   (*b*). Var. compressa, Le Jolis. Pictou harbour, *MacKay*; Frye's Island, St. John, *Hay*.
   (*c*). Var. intestinalis, Le Jolis. Very common, Richibucto River, *Fowler*; St. John, *Hay*.

7. U. clathrata, Ag. On *Zostera marina*, Pictou, *MacKay;* Miscou Island, *Hay.*
8. U. Hopkirkii, (McCalla) Harv. Pictou harbour, *MacKay.*
9. Ulothrix collabens, (Ag.) Thur.? Grand Manan, *Hay.*
10. Chætomorpha melagonium, (Web. & Mohr.) Kutz. Halifax harbour, *MacKay.*
11. C. Picquotiana, (Mont.) Kutz. Halifax, *Harvey* in *N.B.-Am.*
12. Rhizoclonium tortuosum, Kutz. Halifax. *Harvey* in *N. B.-Am.*; Shippegan Island, *Hay.*
13. Cladophora arcta, (Dillw). P. E. Island, *Dr. Jeans;* Halifax, *Harvey;* Grand Manan and Frye's Island, *Hay.*
14. C. lanosa, (Roth) Kutz, Var. uncialis, Thuret. P. E. Island, *Jeans.* Halifax, *Harvey.*
15. C. rupestris, (Linn.) Kutz. Shippegan Island, *Hay.*
16. C. refracta (Roth) Areschoug. Frye's Island, *Hay.*
17. C. glaucescens, (Griff.) Harv. Halifax, *Harvey;* North Miscou, *Hay.*
18. C. flexuosa, (Griff.) Harv. Miscou Island, *Hay.*
19. C. gracilis, (Griff.) Kutz. Frye's Island, *Hay.*
20. Phyllitis fascia, Kutz. Halifax, *Harvey.*
21. Scytosiphon lomentarius, Ag. Halifax, *MacKay;* Frye's Island, Caraquet, Grand Manan, *Hay.*
22. Punctaria latifolia, Grev. Halifax, *Harvey.* Var. zosteræ, Le Jolis. Mouth of Pictou harbour, *MacKay;* Halifax, *Harvey.*
23. P. plantaginea, (Roth) Grev. P. E. Island, *Jeans.*
24. Desmarestia aculeata, Lam.x. Pictou, *MacKay;* Kouchibouguac Bay, *Fowler.*
25. D. viridis, Lam.x., Halifax, *Harvey*; Frye's Island, Grand Manan, Miscou, *Hay.*
26. Dictyosiphon fœniculaceus, Grev. Pictou, *MacKay.* This species has been found growing as regular branches from a stem formed of the filiform frond of *Chordaria flagelliformis*, at Pictou, in such a manner that the whole appeared to be but one plant. The conundrum was—how can the microscopic section of the branch show the structure of *Dictyosiphon*, while that of the stem shows with equal distinctness the structure of *Chordaria?* Further examination, of course, demonstrated the character of the interesting union. Frye's Island, Grand Manan, Miscou, *Hay;* Kouchibouguac Bay, *Fowler.*
27. Ectocarpus tomentosus, (Huds.) Lyngb. P. E. Island, *Jeans.*
28. E. confervoides, (Roth) Le Jolis. P. E. Island, *Jeans.* Var. siliculosus, Kjellman. Pictou, *MacKay;* Frye's Island, Caraquet, Miscou, *Hay.*
29. E. littoralis, Lyngb. Pictou, *MacKay;* Grand Manan, Miscou, Shippegan, *Hay.*

30. E. fasciculatus, Harv. Caraquet Bay, *Hay.*

31. E. brachiatus, Harv. P. E. Island, *Jeans.*

32. E ———— (?) (A still undefined species). Shippegan Island, *Hay.*

33. Elachistea fucicola, Fries. Pictou, *MacKay;* Halifax, *Harvey;* Frye's Island, Miscou, Grand Manan, *Hay.*

34. Leathesia difformis, (Linn.) Areschoug. Halifax, *Harvey.*

35. Chordaria flagelliformis, Ag. Pictou, *MacKay;* Halifax, *Harvey;* Frye's Island, Caraquet, *Hay.*

36. Mesogloia divaricata, Kutz. Pictou, *MacKay;* Frye's Island, *Hay.*

37. M. vermicularis, Ag. Halifax, *Harvey.*

38. Castagnea Zosteræ (Mohr.) Thuret. Halifax, *Harvey.*

39. Chorda filum, Linn. Pictou, *MacKay;* Frye's Island, Gulf Shore, *Fowler, Hay.*

40. Laminaria longicruris, De la Pyl. Halifax, *MacKay* and *Harvey.* Stipes three or four yards long have been observed. Prof. Lawson, of Dalhousie College, says that on taking charge of chemistry on his arrival at Halifax he could get no rubber tubing in the city. While his order was coming he used the hollow stipes of this sea-weed, which is always cast up in abundance on the Halifax coast, and found it to answer splendidly for the conduction of gas.—*MacKay.* A specimen of this plant thrown on the Caraquet beach measured seventeen feet in length, and the widest part of the blade from two to three feet wide. But in the masses of sea-weed thrown on the southern shores of Shippegan and Miscou still larger specimens were observed. One measured twenty-eight feet, while the stipe of another which was all that could be pulled from the debris, measured fifteen feet. This species makes up the great portion of the laminariæ growing along the gulf shore of New Brunswick. It is distinguished by its hollow stipe. Around Grand Manan and the southern coast of New Brunswick the forms of laminariæ are far more variable and confusing, the two following species (L. saccharina and L. digitata) being most abundant.—*Hay.*

41. L. saccharina, (Linn.) Lam.x.? Pictou, *MacKay;* Halifax, *Prof. Lawson;* Frye's Island, Grand Manan, *Hay;* Gulf St. Lawrence, *Fowler.*

42. L. digitata, Lam.x. Pictou, *MacKay;* Halifax, *Harvey, Lawson;* Grand Manan, *Hay.* (The stipes of this species are used by surgical instrument makers in the manufacture of sponge-tents.)

43. Saccorhiza dermatodea, De la Pyl. Halifax, *Harvey;* Grand Manan, *Hay.*

44 Agarum Turneri, Post. and Rupr. Halifax, *MacKay, Harvey, Lawson;* Grand Manan and Frye's Island, *Hay.*

45. Alaria esculenta, Grev. Halifax, *MacKay*, *Harvey*, *Lawson;* Grand Manan, *Hay.* (This species is used as food in Scotland and Ireland, where it is called badder-locks, henware, murlins,—and also in Iceland, but it is not eaten with us—*Dr. Farlow*).

### ORDER III.—OOSPOREÆ.

46. Ascophyllum nodosum, Le Jolis. Pictou, *MacKay;* Halifax, *MacKay* and *Harvey;* very common on southern coast of New Brunswick, *Hay*, *Fowler.*

47. Fucus vesiculosus, L. Pictou and Halifax, *MacKay;* Halifax, *Harvey.* The varieties of this species are very abundant between tide marks on the southern shores of New Brunswick, *Hay*; Gulf shore, *Fowler.*

48. F. serratus, L. Pictou, *Fowler;* Pictou and Pictou Island, *MacKay.* Not found elsewhere in N. E. America.

49. F. evanescens, Ag. Frye's Island, Grand Manan, *Hay.*

50. F. furcatus, Ag. Growing on the low, flat shores northwest side of Miscou Island, beyond low water mark, *Hay.*

51. Vaucheria ———— (?) Pictou, *MacKay.*

### ORDER IV.—FLORIDEÆ.

52. Porphyra laciniata, Ag. Pictou, *MacKay;* Halifax, *Harvey;* Frye's Island and Grand Manan, *Hay.*

53. Bangia fusco-purpurea, Lyngb. Halifax, *Harvey.*

54. Callithamnion Rothii, Lyngb. Halifax, *Harvey.*

55. C. Pylaisæi, Mont. Southern Head, Grand Manan, washed ashore in great abundance at the base of the cliffs, *Hay.*

56. C. Americanum, Harv. P. E. Island, *Jeans;* Halifax, *Harvey.*

57. C. corymbosum, Lyngb. Halifax, *Harvey.*

58. Ptilota elegans, Bonnem. P. E. Island, *Jeans.*

59. P. serrata, Kutz. Halifax, *Harvey;* Grand Manan, Frye's Island, Shippegan, *Hay.*

60. Ceramium rubrum, Ag. Very abundant. Pictou and Halifax, *MacKay;* Frye's Island, Shippegan, *Hay;* Kouchibouguac Bay, *Fowler.* Var. proliferum, Ag. Little Shippegan Bay, *Hay.*

61. C. circinnatum, Kutz. Little Shippegan Bay, *Hay.*

62. C. tenuissimum, (Lyngb.) Ag. Pictou, *MacKay.*

63. Halosaccion ramentaceum, (L.) Ag. Halifax, *MacKay;* Frye's Island, *Hay.*

64. Phyllophora Brodiæi, Ag. Halifax, *Harvey.*

65. Ahnfeldtia plicata, Fries. Pictou and Halifax, *MacKay;* Caraquet, Frye's Island, *Hay;* Gulf St. Lawrence, *Fowler.*

66. Cystoclonium purpurascens, Kutz. Halifax, *MacKay;* Miscou Island, *Hay.*
67. Chondrus crispus, (Linn.) Stack. Pictou and Halifax, *MacKay;* Meogone Island, Frye's Island, *Hay;* Gulf of St. Lawrence, *Fowler.*
68. Rhodymenia palmata, (Linn.) Grev. Pictou and Halifax, *MacKay.* Very abundant on the Gulf shore and southern coast of New Brunswick, *Fowler*, *Hay.* (This and *Chondrus crispus* form the the only sea-weeds on our coasts collected for edible purposes. *Chondrus crispus* (Irish moss) yields a gelatine that is nutritious as food, and on the coasts of Ireland and Scotland helps to lengthen out the food supply in times of scarcity. *Rhodymenia palmata* (dulse) is largely exported from St. John and other ports in the Bay of Fundy to the United States and Upper Provinces. About fifty tons were exported from St. John last season, with probably an equal amount from all the other ports on both sides of the Bay. At Dark Harbour, Grand Manan, in August last, I found the fishermen to the number of forty or fifty, engaged in gathering dulse of very fine quality, for export. As the season occurred during a slack time in fishing, this new industry was found to be very profitable, the dulse selling from three to five cents a pound. It is eaten, says Dr. Farlow, by sailors and the Irish population of sea-port towns; but others appear to be cultivating a taste for it. It possesses anthelmintic properties.
69. Rhodophyllis veprecula, J. Ag. Halifax, *Harvey;* Grand Manan, *Hay.*
70. Euthora cristata, J. Ag. Halifax, *Harvey;* Grand Manan, *Hay.*
71. Polyides rotundus, Grev. Pictou and Halifax, *MacKay.*
72. Delesseria sinuosa, Lam.x. Halifax, *Harvey;* Frye's Island, Miscou, *Hay.*
73. D. alata, Lam.x., Var. angustissima, Harv. Very abundant on south side of Miscou and Shippegan Islands where it is cast ashore with the larger sea-weeds, *Hay.*
74. Gracillaria multipartita, J. Ag. Pictou, *MacKay;* Kouchibouguac Bay, *Fowler.*
75. Odonthalia dentata, Lyngb. Halifax, *Harvey.* Pictou, *MacKay,* Kouchibouguac Bay, *Fowler.* Shippegan and Miscou, *Hay.* Not reported south of the Maritime Provinces.
76. Rhodomela subfusca, Ag. Halifax, *MacKay;* Frye's Island, Grand Manan, Miscou, *Hay.* Var. gracilior, J. Ag. Kouchibouguac Bay, *Fowler.*
77. Polysiphonia urceolata, (Dillw.) Grev. Halifax, *Harvey;* P. E. Island, *Jeans;* Pictou, *MacKay;* Miscou and Shippegan, *Hay.* Var. formosa, Ag. P. E. Island, *Jeans.*

78. **P. Olneyi, Harv. Pictou and Halifax,** ***MacKay.***
79. **P. Harveyi, Bailey (?) Pictou,** ***MacKay.***
80. **P. fibrillosa, Grev. North Miscou,** ***Hay.***
81. **P. violaceæ, Grev. Halifax,** ***Harvey;*** **P. E. Island,** ***Jeans;*** **Pictou,** ***MacKay;*** **Kouchibouguac Bay,** ***Fowler.*** **Common along the whole coast New Brunswick,** ***Hay.***
82. **P. nigrescens, Grev. Halifax,** ***Harvey;*** **P. E. Island,** ***Jeans;*** **Pictou,** ***MacKay.*** **Var. fucoides, Ag. Caraquet beach, Miscou gully,** ***Hay.***
83. **P. fastigiata, Grev. Pictou and Halifax,** ***MacKay;*** **Frye's Island,** ***Hay.***
84. **Corallina officinalis, L. Halifax,** ***Harvey.*** **Common on southern and eastern coasts of New Brunswick, and usually found on shells thrown ashore by the waves,** ***Fowler, Hay.***

## ARTICLE IV.

# A PRELIMINARY NOTICE OF A NEW GENUS OF SILURIAN FISHES.

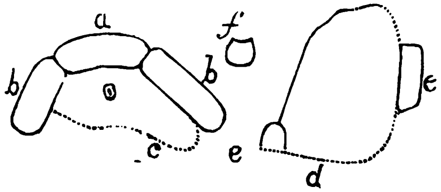
BY G. F. MATTHEW, M. A., F. R. S. C.

(Abstract from the Report of the Field Meeting held in July, 1886; read 5th October, 1886.)

The fish remains of the Silurian age are of two different kinds, one consisting of small spines with fluted surfaces, which resemble those borne by certain sharks and by siluroid fishes. The second consisting of oval and rectilinear plates or shields, with curved surfaces, and which from their form and appearance are not easily recognized as parts of fishes. These plates covered the head and the anterior parts of the body, while the posterior part was protected by scales only, or entirely unarmed. Hitherto all the fishes of this family (Pteraspidæ) have been spoken of as having plates on the head, back and sides only, but the one I am about to describe had ventral plates as well, and in this respect corresponds to the remarkable armoured fishes of the Devonian age.

The most obvious character by which these Silurian fish plates can be recognized is a fine but very distinct ridging of the surface, the details of the ornamentation being governed by the position of the plate in the series of plates with which the body was covered.

The accompanying woodcut shows the outlines of these plates:



Covering plates of Diplaspis Acadica (n. gen.)

*a* is the rostral plate on which the little ridges are arranged parallel to each other, but transverse to the axis of the body. *b, b,* are the two anterior lateral plates on which the ridges are also parallel to each other throughout, and to the longer diameter of the plates. *c* is the dorsal scute, of which only a part is preserved, and in which the circular spot at the anterior end perhaps marks the position of the eye. On this plate the triangular area in front of this circular mark, extending forward to the rostral plate, is also marked by ridglets which are transverse to the axis of the body of the fish, but are not so regular, or so generally parallel to each other as those on the rostral plate. Behind the anterior triangular area on this plate, the little ridges extend backward, parallel in a general way to the axis of the body, to the posterior end of the plate: many of these ridglets are looped at the anterior end, where they are in contact with the triangular area of the plate above described; but going backward they become more distinctly parallel, and one can distinguish two sets, one of smaller and the other of larger ridges; there are about four or five of the more minute ridges between the larger ones; and the latter are not continuous, but result from a greater prominence being given to certain of the minute ridges for a limited distance. This two-ranked arrangement does not characterize the ridges over the whole surface of the plate, but the margins on each side are marked, for a limited width, with parallel ridglets of uniform size, similar to those on the rostral and lateral plates.

*d* is the ventral plate or scute on which the ridglets are similar in their size and arrangement to those on the dorsal scute. In the example found, one side of this plate is wanting. *e, e,* are portions of two lateral plates, which appear to have been posterior in position to the laterals *b* and *b.* *f* is a fragment of a plate on which the ridglets are curved; the position of this plate is doubtful.

As this is the only Pteraspidian fish known which is armoured above and below, it will be the type of a new genus for which the name *Diplaspis* will be appropriate.*

In *Pteraspis* (Kner), which, however, is a Devonian and not a Silurian genus, there is a considerable resemblance in the ornamentation of the shield, and generally in the dorsal armature, to the covering plates of the Acadian fish; but if we attempt to compare the different plates of which the shield of our Pteraspidian fish is composed with those of Pteraspis, they will be found to differ widely from that genus. On the other hand, if the plates *a*, *b*, *b*, and *c*, be compared with those of the genus *Cyathaspis* (Lankester) the correspondence of parts is striking.

In Prof. E. Ray Lankester's monograph on the fishes of the Old Red Sandstone † we appear to have only one example of this genus (*Cyathaspis*) described, for although *Cyathaspis (?) Symondsi* is described under this head, it seems very doubtful whether it should be so referred; and Prof. Lankester appears to have placed it here provisionally only. The typical species, *C. Banksii* (Huxley and Salter), is Silurian, and possesses a set of plates quite analagous to the dorsal covering of the Acadian fish. There is also on the central plate ("dorsal scute") a tubercle, indicated in Prof. Lankester's figures, which holds the place of a similar circular elevation on the shield of the Acadian fossil (see plate c.) In Prof. Lankester's examples of *C. Banksii*, the surface markings appear to have been obscure, except on the rostral and lateral plates; we do not know, therefore, how far the markings on the main plate of each of these two fishes were similar.

Curiously enough, the plate *d* possesses characteristics analagous to those of the scute of the genus *Scaphaspis* (Lankester). The markings on the surface of this plate are almost exactly parallel to those of the "dorsal" scute of *Scaphaspis truncata* (Huxley and Salter), in the fine example figured by Prof. Lankester (plate II., fig. 3, Memoirs cited), and the plate is similarly a little asymmetrical.

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* The specific name has already been given, as it has been described in the "Canadian Record of Science" under the name of *Pteraspis* (?) *Acadica*. 1886, pp. 251 and 252 and 323-5.

† Memoirs of the Palæontographical Society, London. Vol. XXI.

The association of these two types of fish plates at several localities may not be altogether without significance. Thus, in the Downton sandstones of England there are *Cyathaspis Banksii* and *Scaphaspis truncata,* and in the Onondaga variegated shales of Pennsylvania, Prof. E. W. Claypole has found *Palæaspis* * *bitruncata* and *P. Americana.* So far as the form indicates a relationship, it may be said that the former is comparable with the dorsal scute of *Cyathaspis,* as Prof. Claypole has observed, while the latter is not unlike the shield of *Scaphaspis* in outline. It should be remarked, however, that in the course of the surface markings as figured and described by Prof. Claypole, *Palæaspis Americana* differs both from the *Scaphaspis* of the Downton Sandstone and from the ventral plate of our Acadian species.

In one respect the Acadian Petraspid is decidedly of archaic type. The plates *c* and *d* possess the two ranks of striæ, or ridglets, which, according to Prof. Lankester, distinguish the Silurian from the Devonian Petraspidian fishes; the contrast between the larger and the smaller intermediate set of ridges is more marked on *d* than on *c*, and the borders of these plates, as also the whole of the lateral plates and the rostral plate, differ in having the ridges of uniform size. The superior prominence of certain of the striæ in our species (and probably in others) belongs therefore only to the two larger plates of the dermal covering, but it is a useful character to distinguish these older fishes from the more typical Pteraspids of the Devonian Age, in which no part of the dorsal scute presents these strikingly unequal ridges or striæ.

The fineness of the ridglets on the plates of the Acadian fish is quite up to the highest standard of tenuity in the fish plates of Prof. Lankester's Memoir, there being from 150 to 200 of them in the width of an inch.

The plate *c* is abundantly dotted with minute pits apparently marking the sites of mucous glands, which Prof. Lankester mentions as a feature of the shields of Pteraspis: from this he infers that a secreting membrane probably covered

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*** Quart. Jour. Geol. Soc. London, Feb. 1881. This genus is separated from the other Pteraspidian fishes on account of organic differences in the structure of the plates and not because of difference of form.**

the surface of the calcareous plates of Pteraspis. If his reasoning is correct, the plates of the Acadian fish were also probably clothed with a similar covering.

These fish remains were taken from beds of the Silurian System which are found on the southern slope of the Nerepis Hills, in Kings County, New Brunswick. The beds are of very fine texture, being evenly banded, silicious mud rocks or hardened shales. They are similar in aspect to the strata of No. 2 in the Silurian Succession at Passamaquoddy Bay in Charlotte County. No. 3 contains in that neighbourhood a marine fauna similar to that of the Lower Helderburg Formation (equivalent to the Ludlow of England). These fish remains would therefore seem to be as old as the oldest known in Great Britain, though perhaps not quite so old as some found in Pennsylvania by Prof. Claypole.

The beds from which the Acadian fish was taken abound with carapaces of a small species of *Ceratiocaris,* and also contain the remains of a limuloid crustacean allied to *Hemiaspis.*

The genera of Pteraspidian fishes known to the writer are the following:—*

*Palæaspis* (Claypole) Scutum simplex, ovale †—Silurian.

*Scaphasis* (Lankester) Scutum simplex, ovale—Silurian and Devonian.

*Cyathaspis* (Lankester) Scutum in quatuor partes divisum ovale—Silurian.

*Diplaspis* (nov. gen.) Scuta in dorsum et pectorem, in septem (?) partes divisa, ovalia—Silurian.

*Pteraspis* (Kner) Scutum in septem partes divisum, sagittiforme—Devonian.

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* The diagnoses of the second, third and fifth genera are taken from Prof. Lankester's Memoir, cited.

† See footnote opposite.

## ARTICLE V.

## THE CRAY-FISH IN NEW BRUNSWICK.

*Cambarus Bartonii* (FABR.) GIR.

BY W. F. GANONG.

(Read 4th May, 1886. Revised April, 1887).

The only species of Cray-fish or "fresh-water lobster," at present known from New Brunswick waters, is the above-mentioned *Cambarus Bartonii* (Fabr.) Gir. In Maine it occurs in the valleys of the Kennebec and Penobscot Rivers,* but has been supposed to be rare in this Province.

In the Museum of Comparative Zoology at Cambridge, Mass., there is a specimen labelled "St. John, N. B., C. F. Hartt." This is the most easterly point from which the species is known. During the summer of 1885, Mr. S. W. Kain and the writer found it in the St. John River just above Grand Falls, and we have since learned of its occurrence at several points in the St. John River valley. Mr. John Babbit says it is abundant in Green River; Professor Bailey has seen it in Mill and Garden's Creeks, near Fredericton; Mr. J. W. Bailey, on the authority of Mr. Charles Beckwith, reports it from a spring draining into the Nashwaaksis; Mr. Scovil Neales has found it in a stream twenty miles above Fredericton, and Mr. A. T. B. Howard in Long's Creek, twenty-five miles above the same city. It is probably to be found, therefore, almost everywhere in favorable localities in the St. John and its tributary streams.

But it is not confined to this one river. Mr. R. W. Ells, of the Geological Survey, writes that he "caught cray-fishes in the Restigouche and the Upsalquitch Rivers in 1879, in which streams they are quite plentiful." The former locality is the most northerly point now known to naturalists of the occurrence of this species. Mr. Charles Beckwith tells the writer, through Mr. Bailey, that it is exceedingly abundant in the South-west Miramichi also, particularly at the mouth of Gillman Brook. Nothing further is at present known of its distribution in New Brunswick.

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* *A Revision of the Astacidæ.* By Walter Faxon. Mem. Mus. Comp. Zoology, Cambridge, Mass. 1885. p. 62.

The Cray-fish has probably been introduced into this Province by way of the Allegash from the head-waters of the Penobscot. "The St. John and Penobscot are connected by a canal from Telos Lake to Webster Pond, and the divide between the head-waters of the Penobscot and the Kennebec is so low that it is said that in very wet seasons their waters intermingle." * It has probably spread into the Restigouche by way of Grand River, and into the Miramichi by way either of the Nashwaak or of the Shiktehawk or Beccaguimec. Where the sources of these streams are so near each other and interlock in such a fashion as they do, there would be little difficulty in the animal spreading from one to the other, particularly where the divide is low. It is probable that it will be found also in the Nepisiguit and the St. Croix, but extremely improbable that it occurs anywhere in Nova Scotia or Prince Edward Island.

As its distribution is a matter of great interest, the writer would be very glad if anyone knowing of its presence in the waters of the Maritime Provinces would communicate the fact either to the Natural History Society or to him.† It is very desirable, too, that specimens preserved in alcohol should be collected from as many localities as possible, for while it is probable that we have but this one species, it is not impossible that there are more; and if so, they are not unlikely to be new to Science. The Cray-fish inhabits fresh water only, and cannot be mistaken for any other animal. It resembles the lobster very closely in all respects, except size and color; being much smaller than the latter (three to four inches long) and somewhat lighter in hue.

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* Thoreau, *Maine Woods.* Quoted in *Revision of the Astacidæ, op. cit.*, p. 62.

† Address, St. Stephen, N. B.

# APPENDIX.

## THE REPORT OF THE COUNCIL OF THE NATURAL HISTORY SOCIETY OF NEW BRUNSWICK.

JANUARY 18TH, 1887.

The Council of the Natural History Society of New Brunswick, in presenting a report of the work done during the year just closed, would congratulate the Society on the prosperous condition in which it is, and on the steady progress it has made in the past.

### MEMBERSHIP.

During the year there were added to the membership one honorary, two life, five ordinary, five corresponding, and two associate members.

### MEETINGS.

Since the last Annual Meeting eight (8) regular meetings have been held, at which the following papers were read:

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|---|---|
| FEB. 2. | A Communication Describing Human Remains found on the Miramichi near Newcastle.—By A. C. Smith, M. D. |
| " | Distribution of Arctic Plants.—By Prof. James Fowler. |
| APR 6. | Social Science—Treating of Primary Education.—By James A. Estey. |
| MAY 4. | Insect Life During Winter.—By J. V. Ellis, M. P. |
| " | The Cray-fish of New Brunswick.—By W. F. Ganong, A. B. |
| " | The Kames and Terraces of New Brunswick.—By Robert Chalmers. |
| JUNE 1. | Destruction of Birds.—By M. Chamberlain. |
| OCT. 5. | Report of Field Meeting held first July, with Preliminary Notice of a New Genus of Silurian Fishes.-By G. F. Matthew, M. A. |
| NOV. 2. | Marine Mollusca of New Brunswick.—By W. F. Ganong, Ph. B. |
| DEC. 7. | Giant Trilobite, found near St. John.—By G. F. Matthew. |
| " | The Botany of St. John City.—By G. U. Hay, Ph. B. |
| " | The Birds and Plants of Petitcodiac.—By John Brittain. |
| 1887. | |
| JAN. 11. | The Mosses of New Brunswick.—By John Moser. |
| " | Natural History Portion of the Colonial and Indian Exhibition.—By. W. F. Best. |

The Treasurer's Report, for the year ending 18th January, shows the receipts to be $475.33, and the expenditure $242.96. The expenditure has been chiefly for the publication of the Bulletin of 1885-6 (No. V.), and for furniture and material for the museum.

About eighty books and pamphlets have been donated to the library, and several volumes of the *American Journal of Science and Art* purchased to fill deficiencies in the series.

Some valuable additions to the museum have been made during the past year, and among others a collection of the Marine Invertebrates of the Atlantic coast, received from the National Museum at Washington. A variety of other objects have been given of which mention is made in the list of donations. The work in the museum during the past year has been chiefly in the arrangement of part of the geological collections, and in revision and re-arrangement of the mollusca. The museum is very deficient in collections from Mesozoic and Cenozoic formations.

The Botanical Committee have given the results of their work during the season in the Report published herewith. The chairman of this committee has also prepared for the Bulletin a list of the Marine Algæ of the Maritime Provinces, which includes the observations of A. H. MacKay, B. A., of Pictou, N. S. The chairman also reports that valuable assistance was received from Messrs. John Brittain, J. Vroom, W. F. Ganong, C. H. Livingston, and J. Moser.

The Committee on Ornithology report that they have continued their observations on the migrations of birds, and have also added to their knowledge of the distribution, within the limits of the Province, of the species which are known to occur here. The committee desire to acknowledge the efficient assistance that has been afforded them in both branches of their work by Mr. John Brittain, Petitcodiac, Mr. Philip Cox, Newcastle, Miramichi; Mr. Louis M. Todd, Calais; Mr. Howard H. McAdam, St. Stephen; and Mr. Gabriel DeVeber, Gagetown.

The society had no "summer camp" during the past season, but on 1st July a field meeting was held at Nerepis, Station. The most important observation made was the discovery of a fossil fish, which is noticed in one of the articles in this Bulletin. Another geological discovery made during the past year by a member of the Society was that of a very large trilobete (Paradoxides) found near St. John.

The Council has appointed a custodian for the rooms during the winter months, who will be in attendance every Tuesday and Thursday evenings, and on Saturday afternoons, for the purpose of showing the collections to visitors. Members are specially invited to visit the rooms and bring with them any friends who take an interest in natural history.

The Council would again thank the daily press for inserting preliminary notices of meetings.

Among the objects which are worthy of consideration in this Anniversary year, is the establishment of a Public Museum. The limited means at the disposal of your Council have not enabled it to undertake the erection of an edifice suitable for such a purpose, but it has steadily kept in view this public need; it has accumulated much material for furnishing a public museum, and has procured cases and other furniture suitable for protecting and exhibiting the collections in its hands, trusting that public liberality, or private munificence, will eventually provide the building required.

The Council feel it their duty to remind you that this Society has entered upon the twenty-fifth year of its existence. During the past quarter of a century it has passed through some vicissitudes and has not always been as prosperous as at present, but another generation is now coming forward to take up the work begun by the gentlemen who originated this Society twenty-five years ago. Not a few of these have gone to their rest, but a large number still fill prominent and useful positions in the community, and among them our worthy President, who has been at the head of this Society (except for a few years) since its foundation.

Respectfully submitted,

W. J. WILSON,

*Secretary.*

# REPORT OF BOTANICAL COMMITTEE.

The following list embraces additional localities for those plants marked rare, or those for which only one or two stations are given in Fowler's list of 1885; also those new to the Province, found during the past season. The latter are printed in full-face type. It will be seen that nearly twenty species and varieties of flowering plants, new to the Province, have been found during the season. Such investigations are every year leading to increased and more accurate knowledge of the distribution of our flora. Our botanists are by no means confining their attention alone to plant distribution in this Province; one member of the committee has published a list of plants of what must be considered the most interesting botanical section of the Province; others are giving their attention to the cryptogamous flora of the Province.

A closer scientific study of our plants with their economic value is pressing itself upon the attention of our botanists. The student of our plants should be the co-worker of the horticulturist and agriculturist in all those questions in which the latter are deeply concerned: the better protection of fruit and other trees from the ravages of fungi, better plans for the extermination of weeds, the increased cultivation of our native plants and fruits, a more thorough knowledge of the qualities of our medicinal plants. These and other practical questions are becoming of more and more interest to our botanists, and indicate what results may be accomplished by a practical application of plant study.

The numbers below correspond to those in Fowler's list of 1885.

GEO. U. HAY,
J. VROOM,
JOHN BRITTAIN, } *Botanical Committee.*

ADDITIONS TO LIST OF PHANEROGAMS OF NEW BRUNSWICK.

12. Ranunculus multifidus, Pursh. Hampstead, Queens County, and Lakeville, Carleton County, *Brittain.* Tay's Mills, York County, *Moser.*

39. Nasturtium officinale, R. Br. St. Stephen; apparently native, *Vroom.*

73. Polygala Senega, L. Richmond, Carleton Co., *Vroom.*

83. Cerasteum arvense, L. St. Andrews and Fredericton; apparently introduced in both places, *Vroom.*

85. Stellaria longifolia, Muhl. St. Croix River, *W. F. Ganong.*

87. S. uliginosa, Murr. Nashwaaksis, *Vroom.* Quaco, *Brittain.*

89. S. borealis, Bigel. St. Andrews and St. Stephen, *Vroom.*

92. Arenaria peploides, L. Miscou Island, *Hay.*

94. Sagina nodoza, Fenzl. Frye's Island, Caraquet, *Hay.*

97. Spergularia salina, Presl. Shippegan and Caraquet, *Hay.*

121. Impatiens pallida, Nutt. Florenceville, Carleton Co., *Brittain.*

163. Prunus serotina, Ehrh. Not uncommon about Florenceville, Carleton Co., *Brittain.*

174. Rubus hispidus, L. North Head, Grand Manan, *Hay.*

192. Rosa Carolina, L. Probably rare in New Brunswick. "Readily recognized by the fine serration of the leaflets, in connection with narrow stipules and usually hooked spines." Watson says (Proc. Am. Acad., Vol. XX.), "I have seen no specimens from Canada; . . . specimens from New Brunswick, sent as such, prove to be R. lucida." He has since referred to this species one found at St. Stephen, *Vroom.*

193. R. lucida, Ehrh. (not R. parviflora). Flowers two weeks earlier than the last. This is probably our common wild rose throughout the Province; though some specimens which have been placed here may belong to either of the next two species.

193*a* **R. humilis,** Marsh. (R. parviflora, Ehrh). Low; outer sepals always lobed; spines usually slender, always straight. Reported along the shores of the St. Croix River, near St. Andrews, *Ganong.*

193*b*. **R. nitida,** Willd. Usually low and very prickly; sepals entire. Frye's Island, *Hay;* Digdeguash and Canoos, *Vroom.*

195. R. rubiginosa, L., includes R. micrantha, Sm. Roadsides and fences.

218. Drosera intermedia, Drev. and Hayne, var. Americana, D. C., North Head, Grand Manan, *Hay;* Titusville, *Brittain.*

221. Hippuris vulgaris, L. Abundant on Miscou Island, *Hay;* Canoos River, Charlotte Co., *Vroom;* shores of Albert Co., common, *Brittain.*

266*a*. **Viburnum acerifolium,** L. Sprague's Falls, St. Croix River, June, 1886, *Ganong.*

289. Solidago bicolor, L., var. concolor, Torr and Gr. Simonds, Carleton Co., *Brittain.*

319. Erigeron aunuus, Pers. Hampstead, Queens Co., Lakeville, Carleton Co., *Brittain;* Clifton, *Wetmore.*

351. Petasites palmata, Gray. Richmond, Carleton Co, *Rev. F. W. Vroom;* Canaan Forks, Queens Co., *J. Moser;* Petitcodiac, *Brittain.*

389. Vaccinium Pennsylvanicum, Lam. A few white berries of this species were seen at St. Stephen in 1885; and a number of them from different localities, mixed with the common blueberries in the market in 1886, *Vroom.*

416. Primula Mistassinica, Michx. A reduced form at Grand Falls, *Vroom.*

420. Lysimachia thyrsiflora, L. Canaan Forks, *Moser;* Oak Hill, Charlotte Co., *Vroom;* Petitcodiac, *Brittain.*

427. Fraxinus pubescens, Lam. Hampstead, Queens Co., *Brittain;* Sprague's Falls, St. Croix River, *Ganong;* Clifton, *Wetmore.*

433. Gentiana linearis, Fresl. Var. **latifolia,** Gray (=G. alba, Muhl. in part). Rolling Dam, Dumbarton, *Ganong;* Oak Hill, St. James, *Vroom.* [Concerning this interesting plant Dr. Gray writes Mr. Vroom as follows: "I identify it with the Lake Superior plant, which I, in the Flora, and earlier in the Manual, referred to *G. alba.* I call it now *G. linearis,* var. *latifolia,* and shall soon be publishing it under that name with reference to your and Mr. Ganong's discovery."]

460. Ilysanthes gratioloides, Benth. St. Stephen, *Vroom;* Bloomfield, Petitcodiac, *Brittain.*

481*a* **Utricularia resupinata,** Greene. Phipp's Lake, Long Reach, K. Co., July, 1886, *C. H. Livingstone.*

484. Verbena urticæfolia. L. Florenceville, *Brittain.*

493. Hedeoma pulegioides, Pers. Keswick Ridge, York Co., and common in Charlotte Co., *Vroom;* Grand Manan, *Hay.*

507. PLANTAGO LANCEOLATA, L., St. Stephen, *Vroom.*

523. Polygonum hydropiperoides, Michx. St. Stephen, *Vroom.*

536. Rumex orbiculatus, Gray, with R. CRISPUS, L., and R. OBTUSIFOLIUS, L. St. Stephen, *Vroom.*

546. Comandra livida, Richardson. Bliss Island, *Brittain.*

548. EUPHORBIA HELIOSCOPIA. St. Stephen, *Vroom.*

552. HUMULUS LUPULUS, L. At the Falls of the Nashwaaksis, a mile or more beyond the farthest cultivated field. Possibly native, *Vroom.*

567. Betula pumila, L. Miscou Island, *Hay;* Lakeville, Carleton Co., *Brittain.*

676. Salix humilis, Marshal. St. Stephen, *Vroom;* Petitcodiac, *Brittain.*

577. S. discolor, Muhl., var. eriocephala, Anders. St. Stephen; (probably this variety is the common form in New Brunswick), *Vroom.*

593. Juniperus communis, L., var. alpina, L. North Head, Grand Manan, *Hay.*

611. Listera cordata, R. Br. Nashwaaksis, *Vroom;* Frye's Island, *Ganong;* Petitcodiac, *Brittain;* Clifton, *Wetmore.*

678*a* **Sparganium eurycarpum,** Engelm. Shediac and Hillsboro, *Brittain.*

695. Potamogeton natans, L. Clifton, *Wetmore.*

702. P. praelongus, Wulfen. St. Stephen, *Vroom.*

708. P. pectinatus, L Clifton, *Wetmore.*

710. Ruppia maritima, L. St. Andrews, *Vroom;* Pokeseudie Gully, Gloucester Co., *Hay.*

715. Cyperus diandrus, Torr. Riverside, Kings Co., *Wetmore.*

739. Rhynchospora fusca, Roem. and Schultes. Hampstead, *Brittain*; Trout Lake, Charlotte Co., *Brittain.*

740. R. alba, Vahl. Charlotte Co., *Vroom;* Hampton, *Brittain.*

740*a* **Cladium mariscoides,** Torr. Potter's Lake, near St. Stephen, *Vroom.*

746. Carex vulpinoidea, Michx. Near Andover, Hampton, *Brittain.*

749. C. arcta, Boot. Moss Glen, Kings Co., *Brittain.*

749*a* **C. chordorhiza,** Ehrh. Shippegan, *Hay;* Lakeville, Carleton Co., *Brittain.*

754. C. Norvegica, Schk. Whale Cove, Grand Manan, *Hay.*

755*a* C. exilis, Dew. Lakeville, *Brittain;* Trout Lake, near St. George, *Brittain.*

760. C. cristata, Schw. Canoos River, 1883, *Vroom.*

764. C. vulgaris, Fries. St. Andrews, *Vroom.*

774. C. limosa, L. Kendrick's Lake, 1882, *Vroom;* Miscou Island, *Hay;* Trout Lake, Charlotte Co., *Brittain;* Portage Lake, Westmorland, *Brittain.*

781*a* **C. Conoidea,** Schk. St. Stephen, *Vroom.*

782. C. gracillima, Schw. Frye's Island, *Hay*; Petitcodiac and Clifton, *Brittain.*

782*a* **C. plantaginea,** Lam. St. John River, between Florenceville and Andover, *Brittain.*

782*b* **C. retrocurva,** Dew. St. Stephen, *Vroom.*

784. C. oligocarpa, Schk. Long Island in the Kennebecasis, *Brittain.*

784*a* **C. eburnea,** Boot. Tobique Narrows, *Brittain.*

789. C. Pennsylvanica, Lam. St. Stephen, *Vroom;* Petitcodiac. *Brittain.*

802*a* **C. comosa,** Boot. (C. Pseudo-Cyperus, Schw. and Torr., var. comosa, W. Boot.) St. Stephen, 1884, *Vroom;* Lakeville, *Brittain.*

807. C. lurida, Wahl. (C. lupulina, Muhl.) St. Croix River near Little Ridge, St. James, *Vroom;* Petitcodiac, *Brittain.*

820. Panicum dichotomum, var. **nitidum.** St. James, *Vroom.*

829. Leersia oryzoides, Swartz. Charlotte and Carleton Counties, *Vroom;* Kings County, *Brittain.*

834. ALOPECURUS GENICULATUS, L. St. Andrews, *Vroom.*

835. A. aristulatus, Michx. Charlotte Co., *Vroom;* Petitcodiac, *Brittain.*

838. Milium effusum, L. Between Florenceville and Andover, *Brittain.*

840. Muhlenbergia Mexicana, Trin. Simonds, Carleton Co., *Brittain.*

842. Brachyelytrum aristatum, Beauv. Charlotte Co., *Vroom;* Frye's Island, Petitcodiac, Florenceville, *Brittain.*

843*a* **Sporobolus** (Vilfa) **cuspidatus,** Torr. Simonds, Carleton County, *Brittain.*

858. Eatonia Pennsylvanica, Gray. Charlotte County, *Vroom;* Titusville, *Brittain.*

859*a* **Poa alsodes,** Gray. Between Florenceville and Andover, *Brittain.*

867. Graphephorum melicoides, Beauv. Simonds, Carleton County, *Brittain.*

869. Glyceria elongata, Trin. St. David, Charlotte County, *Vroom;* Titusville, K. C., *Brittain.*

879. Festuca nutans, Willd. Bellisle, Bairdsville, *Brittain.*

891. Asprella Hystrix, Willd. Between Florenceville and Andover, *Brittain.*

896. Equisetum hyemale, L. Portage, K. County, Bairdsville, Simonds, Carleton County, *Brittain.*

896*a* **E. variegatum,** Schleicher. Rare. Near Andover, *Brittain.*

921. Onoclea sensibilis, L., var. obtusilobata, Torr. Clifton, *Wetmore.*

# DONATIONS TO THE MUSEUM.

| Date. | Donor's Name and Article Presented. |
|---|---|
| 1886 | |
| Feb. | A. C. Smith, M. D. Newcastle, N. B.—Portions of skulls, brass kettle and glass beads, from graves on S. W. Miramichi River. |
| | Miss E. Turnbull.—Owl, mounted. |
| | A. M. Hamilton.—Fresh-water clams, (*Unio*), from Red River, Manitoba. |
| | D. McL Smith.—Coal plants of six genera, from Lingan, C. B. |
| | T. C. Miles, Copper, silver and lead ores, from Montana, U. S. |
| Apr. | W. M. Smith.—Walrus tusks, Eskimo gloves, harpoon head and line, etc., from Hudson's Bay. Plank eaten by sea-worms, from Pictou, N. S. |
| | Jas. W. Banks.—Eggs and nests of several birds, from St. John Co. |
| | M. Chamberlain.—Ostrich egg. |
| | Jas. F. Ellis.—Bark, wood, leaves and cones of the great red-wood tree of California, (*Sequoia*). |
| | D. McL. Smith.—Specimens of New Brunswick plants. |
| | Henry Poole, C. E.—Block of oil coal, from Stellarton, N. S. |
| | W. F. Best.—Glass sponge, (*Euplectella*), from East Indies. |
| | W. H. Maxwell.—Native flax, (*Phormia tenex*), from New Zealand. |
| May | W. K. Crawford.—Stone implements, from Kings Co. Fossils, from U. S., etc. |
| Oct. | U. S. National Museum.—Crustaceans, (26 species). Marine worms, (11 sp.) Marine Molluscs, (29 sp.) Tunicates, (10 sp.) Polyzoa, (4 sp.) Echinoderms, (16 sp.) Corals, (10 sp.) Sponge, (1 sp.) All from the Atlantic coast of the United States. |
| | Geo. S. Purdy.—Corn pestle, broad celt and grooved axe, from Purdy's farm, Queen's Co. |
| | Clarence V. Wood.—Two stone celts and a fossil tree, (*Dadoxylon*), from Baie Verte, Westmorland Co. |

DONATIONS TO THE MUSEUM.—(*Continued.*)

| DATE. | DONAR'S NAME, AND ARTICLE PRESENTED. |
|---|---|
| 1686 *Oct.* | **W. C. SIMPSON** —Iron tomahawk, from L'Etang, Charlotte Co. |
| | **DONALD HARPER.**—Tusk of Sea Cow or Walrus, from Miscou harbour, N. B. |
| | **GEORGE HARVEY.**—Diatomaceous earth, from Seal Cove, Grand Manan. |
| | **CHARLES BAILLIE** —Felted mass of stubble and lakes weed, made by colonies of worms in eight to thirteen feet water, from Little Kedron L , Charlotte Co |
| | **ROBERT MURRAY.**—Fossil plants, *Lepidodendra* and *Calamites*, from Joggins, N. S |
| *Nov.* | **A. B SHERATON** —Baltimore oriole. |
| | **JER HARRISON** —Centipede, from West Indies. |
| | **JOHN BAXTER, M. D** , Chatham —Two sets of birds' eggs |
| *Dec.* | **W. F. BEST.**—Saurian vertebra and three species of molluscs, (gen. *Gryphœa*, *Lima*, and *Modiola*), from the Lias formation, Stockton, G. B Three molluscs, (gen. *Belmnites* and *Ammonites*), one radiate, (*Pentremites*), from the Oolite, Oxford, G. B. Two echinoderms, (gen. *Galerites* and *Ananchytes* (?) from the chalk formation, Winchester, G. B. Shark's tooth, from Red Crag, Norfolk. Raw Silk, from Bengal, India |

# DONATIONS TO THE LIBRARY.

| Date. | Donor's Name, and Title of Book. |
|---|---|
| 1886 | |
| *Feb.* | **Director Geological Survey, United States**.—Bulletins of United States Geological Survey, Nos 7, 8, 9, 10, 12, 13 and 14; April—Nos 15, 16, 17, 18, 19, 20, 21, 22 and 23; October—Nos 24, 25, 26, 27, 28 and 29. |
| | **United States War Department**.—Expedition to Point Barrow, Alaska. |
| | **Natural History Society**, Montreal.—Canadian Record of Science, vol. I., No. 4; vol. II., No. 1; May, vol.. II, No 2; October, vol. II., No. 3. |
| *Apr.* | A. H. **McKay**, N. S., Pictou.—Notes on the Fresh Water Sponges of Nova Scotia. |
| | **New York Microscopic Society**—Journal, vol. II., No. 1; May, No 2; October, Nos. 5 and 6; November, No. 7. |
| | **Field Naturalist Club**, Ottawa—Transactions, 1884–5. |
| | R W. W **Frink**.—Birds of Brazil, and Portfolio of American Aborigines. |
| | J. F. **Whiteaves**, Ottawa – Contributions to Canadian Paleology, vol. I |
| | **United States Fish Commissioner**.—Report of the the United States Fish Commission, for 1882 (1884). |
| *May* | **Trustees of American Museum of Natural History**, New York—Annual Report; October, Bulletin No. |
| | J. H. **Panton**, Winnepeg.—Transacations of Historical and Scientific Society, Manitoba, No. 20. |
| | **Society Malocologique de Belgique**—Proceedings 1885, January to December. |
| *Oct.* | **Natural History Society**, Glasgow.—Proceedings, vol. I, part 2. |
| | **Brookville Society Natural History Society**—Bulletin No. 2. |
| | **Literary and Historical Society of Quebec**.—Transactions, No. 18. |

Donations to the Library.—*(Continued.)*

| Date. | Donor's Name, and Title of Book. |
|---|---|
| 1886<br>*Oct.* | Geological and Natural History Survey of Canada.—Summary Report for 1885. |
| | Geological Survey of United States —Brachiopods and Lamellibranchs of the cretaceous bed of New Jersey. |
| | J. H. Panton, Winnepeg.—Geology of the Islands of Lake Winnepeg. |
| | Ottomar Novak, Prague.—New Phyllopod Crustaceans in Bohemia. |
| | E. Gilpin, C. E., Halifax.—Quarterly Journal Geological Society, London, Nos. 166 and 167. |
| | Boston Society of Natural History.—Proceedings, vol. I., Nos 2 and 3. |
| | Natural History Museum, Vienna—Annals of, Nos 1 and 2. |
| | Jas E. Briggs —New England Reported. |
| | Essex Institute, Salem.—Bulletin Nos. 4, 5, 6, 7, 8, 10, 11 and 12; November—Nos 1, 2, 3, 4, 5 and 6. |
| | Canadian Institute, Toronto.—Proceedings, vol. II., No 4 |
| | Peabody Museum, Cambridge.—Report, vol. III., Nos. 5 and 6. |
| | United States Department of Agriculture.—Third Report on American Cereals. |
| | Academy of Natural Sciences, Philadelphia.—Proceedings, Part I., Jan. to March, 1886; December, Part II. |
| | Nova Scotian Institute of Natural Science.—Proceedings |
| | Colorado Scientific Society, Denver.—Proceedings. |
| | I. Allan Jack.—Letters on Elements of Botany. |
| *Nov.* | D. McL. Smith, Philadelphia.—Lincoln's Lectures on Botany. |
| *Dec.* | G. F. Matthew.—Pamphlets on the Cambrian Fauna of Scandenavia. |

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# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

## No. VII.

PUBLISHED BY THE SOCIETY.

SAINT JOHN, N. B.:
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1888.

# IN MEMORIAM.

In view of the sudden death of the writer of this address, within a fortnight of the time when it was delivered, its closing paragraphs seem almost prophetic.

Except for a short time during the middle term of its existence, when the late Mr. Jack presided, Dr. L. B. Botsford has been at the head of this society since its organization. Among the many benevolent activities in which he was engaged, it received a large share of his attention. He entered heartily into all its aims and objects, and was always ready to support and encourage any project to extend its usefulness.

For a quarter of a century our late President maintained his warm interest in this society, attending its meetings with the regularity and promptness for which he was noted, and by his facility in public affairs, his ready tact and genial manners, added greatly to the interest of the meetings.

Always ready during his lifetime to aid it with his means, as well as with his influence, the society acknowledges with gratitude that at his death its prospective wants were not forgotten by him.

The following address is the last composition of a public nature that came from his pen.

# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

## ANNUAL ADDRESS OF THE PRESIDENT.

### HISTORICAL SKETCH OF THE NATURAL HISTORY SOCIETY.

"The thing that hath been it is that which shall be." There is no new thing under the sun. In the infinity of differences there is after all an infinity of similarities.

The twenty-fifth anniversary of the Natural History Society of New Brunswick has passed, and the history of our society does not differ from that of similar institutions. Its experience has been like that of others the world over.

The law of progression is not always one continuous advance. Night and day alternate in all things. Individuals, communities, cities, peoples and nations have their ebb and flow, and why not societies ? And such has been the experience of the New Brunswick Natural History Society of this city.

January 29th, 1862, a meeting was held in the Mechanics' Institute for the purpose of forming a society for the cultivation of natural science. Forty-two persons were present. Of that number seven remain upon our roll of membership. Of the others, twelve have died and twenty-three have withdrawn.

At that meeting Mr. William Jack moved, seconded by Mr. J. W. Lawrence, that a scientific association should be formed, and that it be called "The Natural History Society of New Brunswick."

Mr. W. P. Dole moved, seconded by Mr. W. R. M. Burtis, "That it shall be one of the efforts of this society to form a collection of books of a scientific character for the use of the members."

Mr. W. H. Perley moved, seconded by Mr. R. P. Starr, "That it shall be another special aim of the society to form in connection with it such a collection of specimens in the different branches of scientific research as shall fully illustrate the natural history of this Province and, as far as possible, that of other countries." In his remarks Mr. Starr referred to the nucleus of a museum guaranteed to this proposed society by the Steinhammer Geological Club.

Mr. H. W. Frith moved, seconded by Mr. E. Allison, "That in order to carry these views into effect a committee be appointed to prepare a constitution for the society."

The committee consisted of H. W. Frith, Wm. Jack, M. H. Perley, W. P. Dole, R. P. Starr, L. B. Botsford and G. F. Matthew.

February 5th, the committee submitted their report, the constitution and bye-laws were adopted, and the society adjourned to meet February 14th to elect office-bearers.

On the 14th the following were elected: L. B. Botsford, President; M. H. Perley, Vice-President; R. P. Starr, Recording Secretary; H. W. Frith, Corresponding Secretary; G. F. Matthew, Curator and Librarian; W. P. Dole, W. Jack and C. F. Hartt, Members of the Council.

At the first meeting thirty-two members were enrolled, and soon after eight others.

Meetings were held once a fortnight with an average attendance of twenty-five.

At the meeting held November 28th Mr. W. Jack moved, seconded by Mr. Justice Parker, the following resolution: "That the society desire to express their deep regret at the loss sustained by the death of their late lamented Vice-

President, M. H. Perley, Esq." By his death the society lost an active and influential member.

At the annual meeting, January, 1863, the roll consisted of two honorary, ten corresponding, and sixty-nine ordinary members. Of the latter nine had been admitted during the year.

Messrs. Hartt, Matthew, Starr, Payne and Hegan, members of the Steinhammer Club, gave their valuable collection to the society. They were constituted life members.

Dr. C. K. Fiske donated a valuable collection of native aquatic birds. Dr. Fiske was made a life member.

Measures were taken to secure to the society the very valuable collection of Devonian fossils made by Mr. C. F. Hartt.

In 1864 there were in the museum 10,000 minerals and fossils, 2,000 marine invertebrate, 750 insects, 500 plants and 30 birds. Mr. H. F. Perley gave a collection of minerals illustrating the gold formation of Nova Scotia. Mr. Perley was made a life member.

In 1868 the society concluded to secure another place for their meetings and their collection. The basement of the Grammar School, Germain street, was occupied. The change did not prove advantageous. The ebb had fairly commenced! The room was too small; it was gloomy and uncomfortable; its dampness threatened to injure the collections. At this time offers were made to the School Trustees to take charge of the collection for the benefit of the public schools. The Trustees declined the offer. Finally arrangements were made with the Directors of the Mechanics' Institute. During two years only five meetings of the society were held and about as many of the Council.

From 1874 to 1880 the night settled down, and the society slept a quiet sleep! In March, 1880, a meeting to resuscitate the institution was convened. The members present were W. Jack, Esq., President; Dr. Inches, Dr. Hamilton, G. F. Matthew and R. P. Starr.

New energy was infused by the addition of Gen. Warner, U. S. Consul, D. H. Waterbury, J. T. C. McKean, W. N. Gould, G. Ernest Fairweather, C. A. McDonald, W. M.

McLean, G. Herbert Lee, Dr. Coleman, W. F. Best, G. U. Hay and R. Chalmers.

The following gentlemen were appointed to fill the vacancies in the Council: General Warner, Vice-President; G. Ernest Fairweather, Recording Secretary; W. F. Gould, Curator; G. U. Hay, Librarian; D. H. Waterbury, Member of Council.

Regular meetings of the council and society have been held from that time to the present, and the flood-tide of prosperity has continued.

In 1881 arrangements were made to occupy our present quarters. These have been kindly granted us by the City Council.

This same year another step in advance was taken, and the class of associate members instituted very much to the benefit of the Natural History Society.

Mr. G. U. Hay presented the museum with 400 specimens of the native plants of the Province. These were supplemented by a number from Mr. R. Chalmers and Dr. I. A. Jack.

In 1882 our first Bulletin was issued, in which were valuable original papers by members of the society. This year were added to our collection 146 specimens of birds.

Joint action was taken with the Historical Society to secure a permanent building to be a memorial of the centennial of our city; but without success. It was intended to make it answer for general purposes, among them the erection of a suitable museum for our increasing collections. We hope that the time is not distant when such a museum building will be forthcoming to meet our absolute need.

During this year, 1882, Mr. Chamberlain gave several free lectures on Ornithology to the pupils of the public schools. Other members of the society, Dr. Coleman, Dr. Allison, Mr. Best, gave lectures upon different subjects.

The summer field camp was commenced in 1883. It has continued its meetings, and yearly adds to the success of the society. The practical knowledge acquired proves it to be beneficial and almost a necessity for our progress. Donations of the food fishes in our waters were received from Mr. P. Campbell, and many specimens of insects collected near St. John by Mr. Herbert Gould.

In 1884 Mr. G. F. Matthew presented his herbarium of over 2,000 species of foreign plants.

The society has been incorporated, and has a proper seal to stamp our acts. It is evidently now firmly established.

Our Bulletin is yearly issued, and reflects great credit upon the society. It is especially intended for contributions showing original research.

At the request of the Royal Society of Canada delegates have been yearly sent to represent this institution at their annual meetings.

The Provincial Government now gives us an annual grant, and this enables us to extend our usefulness.

During the summer vacation a class composed of the teachers in our public schools availed themselves of lectures given by members of this society. These lectures were the more instructive, as they were illustrated by the abundant material in our museum. It is proposed to extend this course in the future.

During this winter a series of lectures upon different branches of Natural History was inaugurated, and will be delivered by members of the society.

Such is a brief outline of the Natural History Society, embracing a period of twenty-five years. It has passed through the difficulties which generally attend the formation and growth of similar institutions, and we feel confident that it has entered upon a wider field of usefulness.

It has not a numerous membership, and its field is limited, and yet there are some on our little roll of names well known elsewhere, and who have secured a place for themselves in the prominent ranks of science.

During the past century science has wonderfully advanced, and as the years roll on it will lay an ever-widening basis upon which to build substantial palaces of knowledge and truth, at the same time (let us hope) with such good results materially, as well as intellectually, as will enable the race to enter upon the greatest possible amount of enjoyment.

Civilization has prevailed in other ages and in various countries, yet did not build up for itself a permanent home. There have been civilizations which embraced both material and intellectual conditions, yet they crumbled away from material causes or were overthrown by external forces.

The Mexicans of to-day are inferior in many respects to the people of the time of Montezuma. When the Spaniards took possession of Mexico they found conditions of civilization—in the public building, in the civil and social arrangements—superior to those now in existence.

The Indian race has retrograded.

Three and four thousand years ago Egypt contained a powerful nation. Her wondrous pyramids are standing monuments to her supremacy in architecture; her vast temples were the scenes of gorgeous worship; her painted writings disclose the histories of famous kings and successive dynasties, and yet this high civilization has disappeared, and as a nation she grovels among the meanest.

The Chaldeans were celebrated for their knowledge. The Babylonians, Persians, Assyrians, held a prominent place in the history of the world. From the plains of their country or from the lofty towers of their cities they watched and noted the movements of the heavens. Their merchants gathered up the riches of the world; their warriors pushed their dominion over the then known world; their learned men filled their libraries with records of their history and religion. But now many centuries have lapsed since they as peoples have passed away, and huge mounds of brick and clay alone mark the solitudes where kings reigned in pomp and nations revelled in luxuries.

Greece was a centre of intellectual forces. She stood as a beacon and flashed her philosophy like the light over the nations and down the centuries. Yet as a people Greece waned before social and foreign evils, and is chiefly known by the dead past.

The Roman Empire was the most extensive and powerful in the world; culminated in material wealth; cruelty reigned triumphant in her public games; luxury sapped her manhood, and in spite of a century of Augustan learning she was overthrown by barbarians who, with northern vigor, trampled under their feet the standards that had at one time braved the whole world. Of Rome it could be truly said, "The thing that hath been it is that which shall be."

In prehistoric times migrations from the East laid the foundation of the European nations. The evidence of this comes to us in the lost forms of a common language. Out of the North there surged those successive waves of barbarous peoples who overthrew the Roman power in the West; whilst again from the East came the followers of Mahomet. These established their rule in Constantinople, the seat of the last of the Roman Emperors; carried their victorious arms into the heart of Europe; subdued the principalities of the Danube; possessed Greece and established themselves for a time on the fertile plains of Spain.

Is there a possibility that history may repeat itself? Is it possible that with all the knowledge which science is heaping up; with all the inventions which teem from the brain of man; with all the means for offensive and defensive war now in use; with many and powerful nations to maintain their independence, is it possible there can be any further danger to the progress of the world—that no interruption can arise?

Without doubt the causes of disintegration which operated upon the nations of the past will produce similar results when present or future peoples culminate in power and luxury and become subject to these influences. Some of these destructive elements may now be recognized. Science, no doubt, is progressing with wondrous strides, yet is entangling itself in the pursuit of partial truths only. One-sided in their agnostic aspirations the leaders of thought are building upon physical laws another Babel to pierce the heavens. From the lofty towers of this edifice sounds of confused voices descend to us. The foundations of responsibility are being attacked; mankind is thrown back upon a godless morality, a morality with no compass but the wishes or reason of the individual. Wealth is accumulating as in the palmy days of ancient Rome. Lawlessness and anarchy are showing a defiant front.

But, granting that these clouds may pass away, is there no other source of danger? Is there no nation which can possibly change the condition of the world and throw into shade, in the way of conquests, the colossal feats of Ginghis Khan or of Tamarlam? There is a nation which has a history of thousands of years, and though subject to many vicissitudes it has existed virtually as one nation, and to-day has a population of nearly 400,000,000 souls. This people are prolific; they are ingenious, intellectually endowed and industrious; they are extremely national; their land teems with inhabitants, and the very waters are covered with their floating homes. For a long time they have not been aggressive, yet they have, of late especially, pushed their wanderings into other lands. Forty thousand of them occupy the very centre of San Francisco, the chief city on the Pacific coast. During the last century they have been brought into forced contact with other peoples. Despised by all, maltreated by most, yet they are made in the fashion of men, and they must be subject to the ordinary motives and passions which influence the race elsewhere. It is evident that they stimulated, though it be by forced contact, with the ideas of the oppressing foreigners. Is it unreasonable to suppose that some day they may show the power which now lies slumbering under a patient endurance? Goaded by the treatment they have received, is it not possible that a spirit of retaliation may take root and revenge become a watchward in their councils? There are men among them of large and cultivated intellects, men who are beginning to shape their growth; and should one of these masters of men arise, a man who leads and sways and moulds his fellow-men, should such an one avail himself of the tens of millions of his people capable of bearing arms; train them with the strictest military discipline; arm them with the best of weapons, and stir them up to show their manhood, he certainly could be a power on the earth. In a short time that ingenious people could be taught to manufacture their implements of war and build vessels of war after the most improved patterns. In the meantime they could purchase from European sources both arms and ships. Only a few weeks ago a fleet of half a dozen war vessels sailed from China manned by Chinese sailors who, whilst waiting for the completion of the contract by the builders, commended themselves to the English community by their orderly conduct. These vessels were built by a special contract with Chinese officials. With these ships alone the Chinese could easily revenge the cruel treatment perpetrated upon their people on the Pacific Coast. They could readily seize San Francisco, and with the aid of their 40,000 countryman, now in that city, not only destroy it, but sweep American commerce from the coast, and it would be months before sufficient force could be sent there to resist the invasion. "The thing that hath been it is that which shall be" may again be verified, and with the resurrection of that people to new life, another but greater than Genghis Khan may change the conditions of the civilized world. Science, however definite and general it may become; literature, however brilliant; and wealth, however enormous it may be, cannot, singly or combined, secure a permanent civilization. It alone can be so when it is based upon the high principles which flow from the throne of God, for it is righteousness which truly exalteth a nation!

In conclusion, I beg to thank you for the honor conferred upon me for many years. The society has existed for quarter of a century. During the most of that period I have occupied the chair. I am perfectly aware of my short-comings in that position. Your work has made the society what it is. The time has come when I must yield up my position into more efficient hands. "The thing which hath been it is that which shall be." The old must disappear from the scene and the young must take their place. It is so ordered. It is not necessity but duty which demands the change. Not only do I wish that great success may attend the future of the society, but I feel assured that such will be the case. You have material that would secure a prominent position to any society, and I have no doubt that a first rank will be maintained by the Natural History Society of New Brunswick among those of the Dominion.

## ARTICLE I.

# THE ECHINODERMATA OF NEW BRUNSWICK.

BY W. F. GANONG.

## I. INTRODUCTORY.

The Echinodermata have always been to naturalists among the most interesting of Invertebrates. Among the first of the reasons for this is undoubtedly the abundance of hard parts in the group in general, and the constancy with which they indicate specific differences. Indeed, in most of the Echinoderms, the hard parts of the body bear a closer relation to the internal anatomy and are more immediately correlated and connected with it than in any other group of Invertebrates, with the possible exception of the Insects. Again, the comparative ease with which they may in general be collected, preserved and prepared for study, the prominence given to many of them among shore animals by their symmetrical forms, bright colors and conspicuous habitat, the comparative simplicity of their gross anatomy and ease with which they may usually be dissected, the clearness with which they illustrated the old "radiate" type of animal-structure and its relation to other types, as well as important general structural features,—all these, together with the very interesting problems connected with their development and their relation to extinct forms, have caused them to receive a large share of attention from naturalists of all ages, both professional and amateur.

The mere idler by the sea-shore, if he notices animals at all, notices these among the first. Bright in color many of them, symmetrical in form all of them, often abundant and easily found, with powers of slow but easily-watched locomotion, they attract more attention than the duller-colored and more sluggish, though more useful Mollusca, or the more active and shyer Crustacea.

To the teacher there is no group of marine animals which can be made of greater use for teaching purposes. Not only are they interesting for the reasons we have already mentioned, but simply as objects of practical study they possess many advantages. Many of them are easily collected and preserved, and prepared specimens may be made to show more of the internal anatomy than is possible with any other group. Their comparative simplicity of structure and abundance of supporting hard parts make many of them better subjects for dissection than the Mollusca or Crustacea, and their larger size gives them an advantage over the Insecta. They are particularly well adapted, too, for the illustration of many general zoological principles. The habits of the shore forms can be quite easily watched and studied, either upon the shore (which is the best way), or in glass vessels in the school-room. Many simple and harmless experiments may be tried upon them which will teach most valuable lessons, not about Echinodermata alone, but about animal life in general. The mind of a pupil wisely led to observe forms as low as these, will be grasping, though altogether unconsciously, a truer perception of what Nature really is, and a broader sympathy with her workings in the world about him. Seeing in these simple creatures, so different from what he has been accustomed to associate with the name animal, characteristics in common with the higher animals, including himself, he must in his mind link closer together what before seemed far apart, must include in one category what before seemed different in kind, and thus will come a step nearer to that conception, grand and ennobling when fully grasped, the true basis of all scientific knowledge,—the fundamental unity of Nature.

That the proper kind of study of animals and plants affords the best means that we have of arousing and exercising powers of observation and inductive reasoning, is too well known to require repetition. But teachers should not forget that before they can make use of this means towards the much to be desired end, they must be trained in these respects themselves. To those who live within reach of the sea-shore, the group we are considering is a particularly good one for self-training. Those who may take up the study can have the additional stimulus of knowing that they may at any time add to science a substantial contribution. Problems are waiting everywhere for solution, and many of them are within the reach of any patient and accurate observer. Almost nothing is known of the habits of even our most common Echinoderms, not enough to give us any clear idea to what features of their environment their very peculiar structure is adapted. We cannot doubt that the ten rays of *Solaster*, or the five of *Cribrella*, or the spine-clusters of *Crossaster*, or the marginal web of *Pteraster*, are as exquisitely adapted to some conditions of those animals' lives as is the structure of a flower to cross-fertilization by Insects.

No one of the Echinoderms of our coast has any special economic value. Doubtless this fact explains why they have been so little noticed by those early writers who treated of the natural history of the Province. Early works which have chapters on the Mammals, Birds, Reptiles and Fishes, quite ignore this group, though mentioning the edible Mollusca and Crustacea. The earliest reference to the Echinoderms of this region is found in "Les Voyages du Sieur de Champlain," written by Champlain himself and published at Paris in 1613. He mentions the occurrence of Sea-urchins in 1604 on Saint Croix (now Dochet or Neutral) Island; "Autour de notre habitation il y a de basse mer quantité de coquillages, comme coques, moulles, ourcins & bregaux qui faisoyent grand bien a chacun." Lescarbot and Denys seem to make no mention of the group, though the latter wrote a book on the natural history of this part of Canada. No work seems to contain any reference to them up to Cooney's "History of Northern New Brunswick and Gaspé," in 1832, which mentions among the "shell-fish" of the Province, the Starfish and Sea-urchin. Rev. C. Atkinson, in 1844, mentions the Starfish and Sea-spider; the latter is the name by which *Gorgoncephalus Agassizii*, or the Basket-fish, is known to the fishermen, and it may have been to it he referred, or it may have been to some species of crab. Gesner, in his "Industrial Resources of Nova Scotia," in 1849, gives among the "marine and fresh water fishes of Nova Scotia, New Brunswick and Prince Edward Island," *Asterias rubens*, *Starfish*, but no others. Neither Perley nor Adams, in their writings on our Zoology, mention any of the Echinodermata.

The first paper by a naturalist, dealing with this region, is by William Stimpson (afterwards Dr. Stimpson), in the Proceedings of the Boston Society of Natural History, Vol. IV., 1851, (B).* In it he describes before the Society the results of a visit to Eastport, mentions the Invertebrates he found there, and gives brief notes upon several species of Echinoderms. He noticed the northern character of the fauna of this region, and seems to have been the first to have done so. He explained it by the depth of the water and the mixing up by the strong tides of the colder bottom with the warmer surface water, the temperature of which could therefore never become high. The prevalence of fogs, too, he thought kept the sun's heat from exerting its full power upon the water. Three years later, in 1854, the same naturalist published the most important work which has yet appeared on the Invertebrates of New Brunswick, his "Synopsis of the Marine Invertebrata of Grand Manan: or the Region about the Mouth of the Bay of Fundy, New Brunswick," (D). Dr. Stimpson spent three months of the summer of 1852 dredging around Grand Manan, finding there many new species of Invertebrates. In the Synopsis he mentions twenty-five good species of Echinoderms, three of them new. This work is an annotated list, giving descriptions of new species only.

In 1861, Mr. C. B. Fuller published in the Proceedings of the Portland Natural History Society (G), some notes on the Invertebrates of Eastport Harbor, and in 1863, in the second report on the Natural History and Geology of the State of

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* See the Bibliography following.

Maine, a much longer list (H), containing references to many Echinoderms found at Eastport and in the Saint Croix River.

In 1866, Professor A. E. Verrill published a very valuable paper entitled,—"On the Polyps and Echinoderms of New England, with Descriptions of new Species," (L). This corrects the synonymy up to date, and gives the range and habitat of every Echinoderm then known upon our coast. In 1871, a short paper by the same author in the Bulletin of the Essex Institute (N), referred to the Invertebrates found in the vicinity of Eastport and the character of the life in the different channels among the neighboring islands. It gives us quite a complete list of the Echinoderms of Eastport Harbor.

In 1872, an exploring expedition of the United States Fish Commission had its headquarters at Eastport, and thoroughly examined the waters of the vicinity. The general results were published by Professor Verrill in a series of articles in the American Journal of Science (R), and scattered through them are a few references to the Echinodermata. They are, however, more important for the knowledge they give us of the depths, temperatures, tides, etc., of the region,—in a word, of its physiography. A complete report, embodying the results of his seven years' work in the Bay of Fundy, is promised us by Professor Verrill. This will describe some new species and add to the Bay of Fundy fauna several not described in the following pages. Professor Verrill also refers frequently in his report on the Invertebrate animals of Vineyard Sound (Q), to the fauna of the Bay of Fundy. Nothing more seems to have been done upon the southern coast, until the writer in a short paper (X), read before this Society and published in its Bulletin No. IV., together with a note in Bulletin No. V., gave the result of some desultory observations of his own upon the littoral and shallow-water forms of the inlets of the Charlotte County coast.

So much for the Bay of Fundy waters. Our knowledge of the Echinoderm fauna of the "North Shore" is very scanty indeed, and what we have we owe entirely to the observations of Mr. J. F. Whiteaves of the Canadian Geological Survey.

Sir William Dawson, over thirty years ago, was acquainted with the littoral fauna of the southern part of the Gulf, but he never published anything upon it. During the summers of 1871-72-73, Mr. Whiteaves dredged in the deeper, and to a limited extent in the shallower parts of the Gulf of St. Lawrence, but was able to give but little attention to the latter. From our whole North Shore, excluding for reasons presently to appear the deeper parts of the Gulf of St. Lawrence and its outliers, Orphan and Bradelle Banks, we have recorded only eight or nine species of Echinoderms. It must, however, be remembered that the shoal and sandy character of the region is not favorable for an abundance of this group, which prefers rather deep and rocky situations. Mr. Whiteaves' results, including much valuable material on the physiography of the region, were published in a series of papers (P), which will be found described in the Bibliography. We wish very much to have filled this gap in our knowledge of the Invertebrate Zoology of the Province, and any of our teachers who may live upon the North Shore will be rendering to it a real service if they will help to make known to this Society what species are to be found upon the shores and in the shallow waters of the Gulf of St. Lawrence. There is work of this kind to be done, too, upon the Bay of Fundy coast, for we know nothing of the distribution of forms beyond Charlotte County. How far up the Bay any of them extend we do not know.

In the coast waters of New Brunswick, as limited in this paper (no fresh-water Echinoderm whatever is known), there have been found twenty-eight good species of this group.* Of these the majority are forms of wide distribution, but a few of them have some special interest.

Such is the case with our one Crinoid, our single representative of a group which is of such great palæontological importance. It is a *Comatula,* one of that division of the Crinoids in which the adult is free but the young is stalked. But there is some question about its exact identity. Dr. Stimpson in his Synopsis tells us that he dredged a single specimen of a *Comatula* in twenty-five fathoms near Duck Island, Grand Manan. He referred it, though doubtfully, to *Alecto* (now *Antedon) Eschrichtii,* finding differences which he thought might be due to age, as his specimen was only four inches in diameter, while those with which he compared it were at least ten. Dr. P. H. Carpenter, in his forthcoming report (Y), on the Crinoids of the CHALLENGER expedition (for advance sheets of which the writer cannot sufficiently thank him), suggests that Stimpson's specimen may have been *Antedon quadrata,* a smaller species of similar distribution which very greatly resembles and is very closely allied to *Antedon Eschrichtii.* Small specimens of the latter species, together with the former species were dredged by the "Challenger" off Nova Scotia, at the same locality on Le Have Bank, latitude 43° 4′ N., longitude 64° 5′ W., this being the most southerly known locality for both species. The known facts of distribution of the two species, therefore, do not help us, and as Dr. Stimpson's specimen was probably lost in the great Chicago fire of 1871, in which so much of his valuable material was destroyed, the question can now only be settled by its re-discovery. Whichever it may prove to be, it certainly is very rare in the Bay of Fundy, for the thorough dredgings of the United States Fish Commission failed to discover it. How the two species may be distinguished will be pointed out in the description of *A. Eschrichtii.*

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* This is the number which the writer had found reported at the time of writing this paper, and it probably includes all that have ever been reported *in print*. As this paper is passing through the press, however, Prof. Verrill, in a letter to the writer, says that there are many other species known to him to occur in the Bay of Fundy, all of which will be referred to in a future report. Prof. Verrill mentions specially six more Holothurians, three Starfishes and four Ophiurans.

Of Ophiuroids we have six species, all of them rather common forms. The most interesting is *Gorgonocephalus (Astrophyton) Agassizii,* the basket-fish, which is found upon the southern coast, on Bradelle Bank, and at one or two other points in the Gulf of St. Lawrence.

Of true Starfishes we have eleven species, all of them of rather wide distribution, but some of them remarkable either for beauty of coloring or the arrangement of their hard parts. *Goniaster phrygiana* or *Crossaster papposa* are examples of the former, *Ctenodiscus crispatus* of the latter. It is an interesting question whether *Asterias Forbesii* will upon further search be found upon our North Shore. This is a Starfish which is very abundant on the coast in and south of Massachusetts Bay, associated there with *Asterias vulgaris*, the common form of our own shores. It belongs essentially to the southern fauna which occupies the great shallow basin of the southern part of the Gulf, and has been found by Prof. Verrill at Casco Bay, Maine, where a similar isolated southern colony occurs. It seems altogether probable, therefore, that it will be found in Northumberland Straits, the more especially as *Caudina arenata*, a southern Holothurian of very similar range, occurs there. It may be readily distinguished when alive from *A. vulgaris* by its usually greenish color and the bright red madreporic body in the angle between two of the rays, that of *A. vulgaris* being yellow. The only one of the Starfishes which is of any economic importance is the last-mentioned species, *Asterias vulgaris*, which is sometimes but to a very limited extent used as a fertilizer. It is also very injurious to oyster-beds, devouring great numbers of oysters.

Of Echinoids or Sea-urchins we have but two species in the Acadian fauna proper, and one straggler from the colder waters of the Nova Scotia banks. The two former *Strongylocentrotus dröbachiensis* and *Echinarachnius parma* are remarkable for their wide distribution, and *S. dröbachiensis* for its great abundance. One can appreciate when he sees our shores in some places fairly carpeted with this species, the well known fact that as we approach the poles the number of species diminishes but that of individuals increases. In some parts of the world Sea-urchins are eaten, but ours probably have little value for such a purpose, though Dr. Stimpson has tried them and found them edible, and the Exquimaux are said to eat their "spawn" or ova. *Echinarachnius parma*, according to Prof. Verrill, has a limited economic value for the indelible ink which may be made from its pulverized skin and spines.

Of Holothurians there are seven or eight species in our waters, only three or four of which are common. It is in this group, if anywhere, that utilizable Echinoderms occur. In certain parts of the world, Holothurians are greatly esteemed as articles of food. A Mediterranean species is eaten in Naples; and the Chinese and Malays are exceedingly fond of it, so much so that it is among them a very important article of trade, the business employing hundreds of small vessels annually. They are generally known as Trepangs, and are prepared by being cleaned, dried and pressed. Our Holothurians belong to different genera, and may not be utilizable in this way to any extent. But the subject has not been left altogether uninvestigated, for Dr. Stimpson tells us that while in Nova Scotia he tried them with satisfactory gastronomic results. In the Proceedings of the Boston Society of Natural History, Vol. IV., 1851, p. 100, we find this passage: "As to the value of the Holothuridæ as articles of food, Mr. Stimpson said he had availed himself of the abundance by which he was surrounded at Nova Scotia, and had found them (*i. e.* the Holothurians) when boiled, quite as palatable as lobsters. The same was true of some of the Echini of that region." He undoubtedly refers to the common *Pentacta frondosa* or "sea-pumpkin" which is so abundant upon our southern coast. Alexander Agassiz says of it: "The Pentacta resembles the Trepang, so highly valued by the Chinese as an article of food, and forms a not unsavory dish, having somewhat the flavor of lobster." *Caudina arenata,* a southern Holothurian, is found on the North Shore, but not in the Bay of Fundy.

But we must glance for a moment at the general conclusions in regard to distribution and the like, to which we are led by the study of the Echinoderms in connection with other groups of Invertebrates. The writer has already had the honor to lay before this Society a brief discussion of the relations of the faunæ of the Acadian waters, so that a brief summary will be sufficient here. The extension of our knowledge of the subject can be briefly stated. In 1852, James D. Dana (in the Crustacea of the United States Exploring Expedition) pointed out the existence for the Crustacea of a sub-fauna which extended, according to him, from the eastern point of Newfoundland to Cape Cod, including the southern part of the

Gulf of St. Lawrence. To it he gave the name of Nova Scotia fauna. In 1857 (E), Lütken, from a study of the Echinodermata, established a sub-fauna of coincident range, but gave it the more appropriate name of Acadian fauna, a name which it still retains. In 1863 (I), Prof. Packard, reasoning chiefly from the mollusca collected on the coast of Labrador, came to the conclusion that there was a special colder water fauna occupying a great part of the Gulf of St. Lawrence, distinct from the Acadian fauna proper. This he knew extended outside the Gulf and southward on some of the banks off the Maine coast, particularly St. George's Bank. Being thus, south of Labrador, a shoal fauna, he called it Syrtensian. The later researches of the United States Fish Commission under the direction of himself and Prof. Verrill, defined more clearly its limits and showed that it occupies all the banks off the Nova Scotia and Maine coasts as far as St. George's Bank. They found, also, that it has outliers occupying the deeper parts at the mouth of the Bay of Fundy, and at one or two other points in the Gulf of Maine. Mr. Whiteaves has confirmed the presence of this Syrtensian fauna in the Gulf of St. Lawrence and shown that, with the exception of small outliers on Orphan and Bradelle Banks, it is sharply marked off from the Acadian fauna which occupies the southern part of the Gulf. A line drawn from the northernmost point of Cape Breton Island to the northernmost of the Magdalenes, and thence to the northern entrance of Bay Chaleur will separate these two faunæ. The different marine faunal sub-regions then, of the northeastern coast of America, may be summarized as follows. There is first the Circumpolar, occupying all the region of Davis Strait, the coast of Greenland, and the northern part of the coast of Labrador. South of this comes the Syrtensian, which occupies the southern part of the coast of Labrador, the waters to the east of Newfoundland including the Grand Bank, the Straits of Belleisle, all the deeper parts of the Gulf of St. Lawrence with outliers on Orphan and Bradelle Banks, the passage between Cape Breton and Newfoundland, Sable Island and the other banks off the Nova Scotia and Maine coasts, certain deep portions of the

Bay of Fundy and Gulf of Maine, and St. George's Bank. The Acadian fauna occupies all the southern part of the Gulf of St. Lawrence, probably parts of the southern shore of Newfoundland, the shores of Nova Scotia, all the Bay of Fundy, except the deep Syrtensian area at its mouth, all the coast to Massachusetts Bay, and here it begins to mingle with the southern fauna, named by Lütken the Virginian. South of Cape Cod the latter entirely replaces it, with the exception of Nantucket Shoals, which are still occupied by the Acadian, and a bank off the coast of New Jersey, where the last traces of the latter are found.

The Acadian fauna, however, is not, so to speak, homogeneous. It has been clearly shown that certain portions of it belong more nearly to the Virginian than the Acadian regions. This is the case with a large proportion of the forms in the great shallow southern basin of the Gulf of St. Lawrence, at certain sheltered and isolated points on the Atlantic coast of Nova Scotia and in a portion of Casco Bay, Maine. The fauna upon our North Shore is decidedly more southern than that in the Bay of Fundy, and a sub-division of the Acadian fauna would seem to be possible, though these more southern assemblages may also be considered simply as Virginian outliers. The causes determining this curious distribution of faunæ are purely physical, and have already been discussed by the writer before this Society.

Harvard University, Cambridge, Mass.,
February 4th, 1888.

## II. BIBLIOGRAPHY.

It is thought that the following list includes all works and papers of importance which relate to New Brunswick Echinodermata. Only the most important, most generally useful, and most easily accessible structural or systematic works are given; reference to them will show the student bibliographies of others of like character. A few popular works, such as those of Forbes (A), and Agassiz (K), have been introduced on account of the exceptionally interesting way in which they treat the subject. One or two others, such as the papers of Fuller (G), etc., are added for the sake of completeness rather than for any special value they have.

(A) 1841. **Forbes, Edward.**

A History of British Starfishes and other Animals of the Class Echinodermata. *London.* 8vo. xx.+269 pp., woodcuts.

(A truly classical work and one of the greatest interest, as well as of very considerable value to all students of our Echinodermata).

(B) 1851. **Stimpson, William.**

[Observations on the Fauna of the Islands at the mouth of the Bay of Fundy, and on the extreme northeast corner of Maine]. *Proceedings of the Boston Society of Natural History,* Vol. IV. pp. 95-100.

(A paper more interesting historically than otherwise, as its substance is embodied in his Synopsis).

(C) 1851-1854. **Ayres, W. O.**

[Descriptions of new Holothuridæ]. *Proceedings of the Boston Society of Natural History,* Vol. IV.; a series of papers, but particularly pp. 25, 35-37, 52-53, 143-145, 243-246.

(Very valuable for the descriptions of our Holothurians).

(D) 1854. **Stimpson, William.**

Synopsis of the Marine Invertebrata of Grand Manan: or the Region about the Mouth of the Bay of Fundy, New Brunswick. *Smithsonian Contributions to Knowledge,* Vol. VI. 4to. 67 pp., 3 Plates.

(Much the most important work that has yet appeared specially upon the Invertebrate Fauna of this region.)

(E) 1857. **Lütken, Chr. Fr.**

Om de Nordiske Echinodermers Geographiske Udbredning, [On the Geographical Distribution of Norwegian Echinoderms]. *Videnskabelige Meddelelser. . . . I Kjöbenhavn.* 1857-59. pp. 56-100.

(In this paper Lütken establishes the Acadian Fauna).

(F) 1858. **Lütken, Chr. Fr.**

Addimenta ad historiam Ophiuridarum. Parts I. and II. *Kjöbenhavn.* 4to. 169 pp., 7 plates.

(Important for its descriptions and figures of Ophiuroids).

1. **Fuller, C. B.**

Note on the Marine Animals of Eastport Harbor]. *Proceedings of the Portland Natural History Society*, Vol. I., p. 91.

**entions a few Echinoderms. Given for the sake of completeness).**

8. **Fuller, C. B.**

eport on Marine Zoology [of Maine]. *Second Annual Report upon the Natural History and Geology of the State of Maine*, 1862, pp. 129-133.

**ontains references to Echinoderms found at Eastport and in the St. Croix River).**

**Packard, A. S., Jr.**

list of Animals dredged near Caribou Island, Southern Labrador, during July and August, 1860. *Canadian Naturalist*, Vol. VIII., pp. 401-429, 2 plates.

lso—Observations on the Glacial Phenomena of Labrador and Maine, with a View of the recent invertebrate Fauna of Labrador. *Memoirs of the Boston Society of Natural History*, Vol. I., 1867., pp. 210-303, 2 plates.

**mportant for their bearing on the Syrtensian Fauna of the Gulf of St. Lawrence.)**

**Lyman, Theodore.**

phiuridæ and Astrophytidæ. *Memoirs of the Museum of Comparative Zoölogy*, Cambridge, Mass., Vol. I., (Illustrated Catalogue No. 1) 4to. vii.+200 pp., woodcuts and 2 plates.

**he most important systematic work on New England Ophiuroids).**

5. **Agassiz, Elizabeth C. and Alexander.**

aside Studies in Natural History. *Boston.* 8vo. xii.+157 pp., woodcuts.

**valuable book, treating the common New England Echinoderms in very interesting way, and giving good figures of many of them).**

**Verrill, A. E.**

the Polyps and Echinoderms of New England, with Descriptions of new Species. *Proceedings of the Boston Society of Natural History*, Vol. X. 8vo. pp. 333-357.

**very important paper, correcting the synonymy up to date and describing the range on our coast of each species).**

(M) 1867. **Selenka, Emil.**

Beiträge zur anatomie und systematik der Holothurien. [Contributions to the Anatomy and Classification of the Holothurians]. *Zeitschrift für Wissenschaftliche Zoologie* [*Leipzig*]. Vol. XVII., pp. 291-374, 4 plates.

(An important work on our Holothurians, particularly on their anatomy.)

(N) 1871. **Verrill, A. E.**

Marine Fauna of Eastport, Me. *Bulletin of the Essex Institute*, Vol. III. pp. 2-6.

(Describes the character of the tides among the islands, etc., and gives quite a complete list of the Echinoderms of the neighboring shallow waters).

(O) 1872-1874. **Agassiz, Alexander.**

Revision of the Echini. *Memoirs of the Museum of Comparative Zoölogy, Cambridge, Mass.* Vol. III. (Illustrated Catalogue No. 7). 4to. xii.+762 pp., 49 plates.

(By far the best work we have on the Echinoids).

(P) 1872-73-74. **Whiteaves, J. F.**

Reports on Deep Sea Dredging Operations in the Gulf of St. Lawrence. 3 *Reports. Annual Report of the Department of Marine and Fisheries, Canada. Appendix K*, Report for 1870-71, pp. 90-101; *Appendix K*, Report for 1871-72, pp. 118-132; *Appendix U*, Report for 1872-73, pp. 178-204.

These Reports embody the results of the following:

Deep Sea Dredging in the Gulf of St. Lawrence. *Nature*, Vol.V., 1871, p. 8.

Reprinted in *Canadian Naturalist*, Vol. VI., new series, 1872, pp. 351-354.

Notes on a Deep Sea Dredging Expedition round the Island of Anticosti, in the Gulf of St. Lawrence. *Annals and Magazine of Natural History*, iiii., Vol. X., 1872, pp. 341-354.

Reprinted with additions in the *Canadian Naturalist*, Vol. VII., 1873, pp. 86-100.

On recent Deep-Sea Dredging Operations in the Gulf of St. Lawrence. *American Journal of Science*, iii., Vol. VII., 1874, pp. 210-219.

Reprinted in *Canadian Naturalist*, new series, Vol. VII., 1874, pp. 257-267.

(In these Reports and papers are contained nearly everything that we know of the Echinoderm Fauna of the Gulf of St. Lawrence, particularly its deeper parts.)

(Q) 1873. **Verrill, A. E.**

Report upon the Invertebrate Animals of Vineyard Sound and the adjacent waters, with an account of the physical characters of the region. *Report of the U. S. Fish Commission* for 1871-72. 8vo. pp. 293-778, 38 plates and map.

(A very important work, referring frequently to forms which are found in the Bay of Fundy.)

R) 1873-1874. **Verrill, A. E.**

Results of recent dredging Expeditions on the Coast of New England. *American Journal of Science*, Vol. V., pp. 1-16 and 98-106; Vol. VI., pp. 435-441; Vol. VII., pp. 38-46, 131-138, 405-414, 498-505.

(Mentions a few New Brunswick Echinoderms, but chiefly valuable for discussion of physical features of the region, faunal relations, etc.)

(S) 1876. **Verrill, A. E.**

Note on some of the Starfishes of the New England coast. *American Journal of Science*, iii., Vol. XI., pp. 416-420.

(Very important as distinguishing our common shore species of Starfishes).

(T) 1877. **Agassiz, Alexander.**

North American Starfishes. *Memoirs of the Museum of Comparative Zoölogy, Cambridge, Mass.* Vol. V., iv. + 136 pp., 20 plates.

(Treats of the hard parts of several of our Starfishes.)

(U) 1881. **Duncan, P. Martin, and Sladen, W. Percy.**

A Memoir on the Echinodermata of the Arctic Sea to the West of Greenland. *London.* 4to. viii. + 82 pp., 6 plates.

(The most important single work on many of the Echinoderms which occur in this region, and of the greatest value to a student of the group).

(V) 1882. **Lyman, Theodore.**

Report on the Ophiuroidea dredged by H. M. S. CHALLENGER, during the years 1873-1876. *Report on the Scientific Results of the Voyage of H. M. S.* CHALLENGER. *Zoölogy*, Vol. V. 4to. viii. + 386 pp., 48 plates.

(A monograph, practically, of all known Ophiuroids).

(W) 1882. **Verrill, A. E.**

[Review of Duncan and Sladen's Memoir on Arctic Echinodermata]. *American Journal of Science*, iii., Vol. XXIII., pp. 247-248.

(Contains some notes on the range of our species southward).

(X) 1885. **Ganong, W. F.**

On the Zoology of the Invertebrate Animals of Passamaquoddy Bay. *Bulletin of the Natural History Society of N. B.*, No. IV., pp. 87-97.

Also—A Note in *Bulletin No. V.*, pp. 34-36.

(Mentions the occurrence of a few species on the southern coast).

(Y) 1888. **Carpenter, P. Herbert.**

Report on the Crinoidea dredged by H.M.S. CHALLENGER during the years 1873-1876. *Report on the Scientific Results of the Voyage of* H. M. S. CHALLENGER, *Zoölogy*, Vol. —. 4to.

(Has not yet appeared, but will be a most valuable treatise on the Crinoidea).

## III. SYNOPSIS OF THE ECHINODERMATA OF NEW BRUNSWICK.

The present Synopsis is intended to supply, firstly, a list of all Echinodermata known from New Brunswick waters, and, secondly, a guide for their further study. The references to descriptions and figures are not to the first which were given or made of each species, but to the best and most easily accessible. The brief descriptions in the following pages are intended merely as guides to serve as means for the identification of the species, and are not intended to be in any sense anatomical or complete. It is hoped, however, that they will be found accurate as far as they go. Only the superficial characters have been used, and generally such as can be seen at a glance. Technical terms have been as far as possible avoided, and those which are used are such as are self-explanatory or found in any of the elementary zoological text-books. It is only possible to distinguish between species in this superficial way when their number is small and they belong generally to different genera, and such is the case with the species of our waters.

In the nomenclature, the name which is supported by the best authority is in all cases given first. After each is given in brackets the name of the Naturalist who first gave the species the specific name it bears, and after that the name of the one who placed it in the genus in which it appears, or in other words who first used the combination of generic and specific names. When the describer of a species placed it in the genus in which it now remains, his name is given after that of the species without brackets. It will be noticed that pre-Linnæan names have in no case been recognized. One feels great regret at thus passing over such an author as Linck and his grand old work "De Stellis Marinis," but if his nomenclature is adopted that of other works published before the inception of the binominal system of nomenclature must also be recognized, and hopeless confusion would result. The synonymy is only so far treated as is necessary to a proper understanding of the works quoted.

Among our coast waters are included the whole of the Bay of Fundy, but for reasons mentioned in the preceding pages, only the shallower parts of the Gulf of St. Lawrence. For the sake of comparison, however, with the Bay of Fundy fauna, mention is made of the occurrence of species in the deeper parts of the Gulf which occur also in the Bay, and those occurring in the former and not in the latter are given in a separate list. For all localities for which no authority is given the writer is responsible. The letters in brackets refer, of course, to the Bibliography.

# ECHINODERMATA.

Animals having a radial, usually pentamerous arrangements of parts, a skin bearing spicules and hardened, usually to a great degree, by calcareous deposits, a digestive canal, a water-vascular apparatus, and a true vascular system.

## Class I. CRINOIDEA (CRINOIDS).

*Globular or cup-shaped Echinodermata with segmented arms, bearing pinnulæ, usually attached by a calcareous segmented stalk, with plates on the skin of the dorsal side, and ambulacral appendages in the form of tentacles situated in the ambulacral furrows of the disc and arms.*

### FAMILY COMATULIDÆ.

*Stalked only in the young state, adult free, arms ten.*

1. **Antedon Eschrichti,** (MÜLLER), VERRILL. *Alecto Eschrichtii,* MÜLL. et TROSCH. (D). [See Plate, Fig. 1.]
One of the "Comatulæ."

DESCRIPTION. (U) p. 73, (Y) p. 138.

FIGURE. (U) pl. VI., (Y) pl. XXVI.

DISTRIBUTION. (*a*) *General;*—From five to six hundred and fifty fathoms. North Atlantic and Arctic Oceans from Smith Sound to the Vega. Off Nova Scotia in lat. 43° 4′ N., long. 64° 5′ W. Bay of Fundy (?).

(*b*) *In N. B. waters;*—A single small specimen was taken in twenty-five fathoms on a shelly bottom off Duck Island, near Grand Manan, by Dr. Stimpson in 1852.

This species, as is shown by its distribution given above, is decidedly Arctic, and does not belong to the Acadian fauna. Only a single specimen has been yet found, and he who re-discovers it will be fortunate indeed.

It is one of the largest of the Comatulæ, some specimens measuring twenty inches in extreme diameter with the arms outspread. The dorso-central plate bears a great number, even as many as one hundred cirrhi, each consisting of from forty to sixty joints, by which it attaches itself to the bottom. The mouth is in the centre of the upper (though structurally the lower) side, and from it the ambulacral furrows radiate to the ten long arms. The latter ordinarily point upwards, and, having each a double curve, form collectively an urn-shaped figure. Each arm is composed of many joints (up to three hundred in the largest specimens) and bears two rows, which coalesce towards the extremities of the arms, of pinnules, each of which consists of from thirty to one hundred joints, and the lowermost of which, on account of a row of dorsal tubercles, have a serrate appearance.

It lives upon mud, sand and rock bottoms, but almost nothing is known of its habits. In its development from the egg it passes through a metamorphosis, beginning with a barrel-shaped larva with four encircling bands of cilia, and passing on to a stalked stage in which it resembles the adult condition of the fixed crinoids. Afterwards it becomes free.

It has been pointed out (Y), that Stimpson's specimen may have been *Antedon quadrata* and not *A. Eschrichti.* So closely allied are these two species that some naturalists consider them to be one, and at the best it is only with difficulty that they can be distinguished. The shape of certain joints of the arms and relative length of certain pinnnules are the most obvious characters which separate them.

## Class II. ASTEROIDEA (Starfishes).

*Pentagonal or star-shaped dorso-ventrally compressed Echinoderms with ambulacral feet confined to the ventral surface, and internal skeletal pieces in the ambulacra articulated together like vertebræ.*

### Order I. OPHIURIDEA (The Snake-Stars).

*Asteroidea with long cylindrical arms sharply distinct from the disk, not containing appendages of the alimentary canal; ambulacral groove covered by plates so that the ambulacral feet project at the sides of the arms.*

#### FAMILY EURYALIDÆ.

*Mostly with branched arms which can be curved towards the mouth and are without plates, with a soft skin closing the ventral groove.*

2. **Gorgonocephalus Agassizii,** (Stimpson), Lyman. *Astrophyton Agassizii,* St. (D), etc. [See Plate, Fig. 2.] Basket-fish. Sea-spider.

Description. (D) p. 12, (J) p. 186, (U) p. 69.

Figure. (K) p. 151, (U) pl. V.

Distribution. (*a*) *General;*—Low-water mark to 800 fathoms. South of Cape Cod, Bay of Fundy, Gulf of St. Lawrence, Davis Strait, Smith Sound, Vadsö, Finmark.

(*b*) *In N. B. waters;*—Grand Manan, corralline zone, not uncommon, *Stimpson,* (D). Eastport Harbor, "at low-water of spring tides among rocks (mostly small specimens), and abundantly, of all sizes from half an inch to eighteen inches or more in diameter, in fifteen to twenty fathoms, shelly and stony bottom." *Verrill,* (L), (N), (Q). Friar's Cove, *Ganong,* (X). Bay of Fundy, very common, low water to 100 fathoms, *Verrill,* (Q). Bradelle Bank, Gulf of St. Lawrence; *Whiteaves,* (P). Black's Harbor, near Letete Passage, Charlotte County.

This very interesting Echinoderm is quite abundant on our southern coast. It is a true Ophiuran, differing from the common forms chiefly in its greater size and the branching of its arms. The disk, which is from two to two and a half inches in diameter, is pentagonal and covered with a brownish skin having small granules, which, upon the ten very evident radiating ribs, become large tubercles or blunt spines. On the under side the skin is covered with small granules and fills the spaces between the arms, at the bases of which is the mouth with conspicuous papillæ and teeth, and on each side of which, just as they emerge from the disk, are the genital openings. The arms, five in number, as they spring from the disk, immediately divide each into two, the branches again soon dividing in a like manner, the branchlets also dividing, and so on, until at their extremities the arms have become an immense number of very slender, roughened twigs. The branching is not, however, truly dichotomous*—that is, the two branches are never exactly equal, but one is larger than the other—a large and a small one following each other at unequal intervals along any given arm. If the branching were dichotomous, a specimen with twelve forks to each of the arms would have about 20,480 terminal twigs, whereas the mode of branching above mentioned produces about 5,470. The arms are covered above with a rough granular skin of yellow color with no visible external plates; below it is smooth and soft and on the outer under sides of each arm and branchlet runs a triple row of short, blunt spines.

The extremities of the arms can be brought around towards the mouth, and it is usually in this position, having them much tangled and interlaced, that the animal dies, and is seen in preserved specimens, showing well why it is called Basket-fish. While alive, however, it keeps them expanded, using them to catch the small animals which form a part of its food. According to Alexander Agassiz (K), "In moving the animal lifts itself on the extreme end of these branches, standing as it were on tiptoe, so that the ramifications of the arms form a kind of trellis work all around it, reaching to the ground, while the disk forms a roof. In this living house with latticed walls small fishes and other animals are occasionally seen to take shelter; but woe to the little shrimp or fish who seeks refuge there, if he be of such a size as to offer his host a tempting mouthful." It is often brought up by the fishermen on their lines and nets, but owing to its living only in very cold water, it is very difficult to keep it alive. Hence little is known of its habits and nothing of its development. Whether it be viviparous or passes through a metamorphosis is uncertain, but certain points in its structure would seem to indicate the former. The youngest stage ever found had a single fork in the arm, and resembled otherwise a young *Ophiopholis aculeata.*

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* As shown by Mr. Lyman. See *Proceed. Bost. Soc. Nat. Hist. Vol. XIX., 1876-78, p. 102.*

### FAMILY OPHIURIDÆ.

*With simple unbranched arms and ventral plates to the ambulacral grooves.*

3. **Ophiacantha bidentata,** (RETZIUS), LJUNGMAN.

*Ophiacantha spinulosa,* M. et T. (*D*) etc.

DESCRIPTION. (J) p. 93, (U) p. 68.

FIGURE. (F) pl. II., (U) pl. IV.

DISTRIBUTION. (*a*) *General;*—Ten to below one thousand fathoms. South of Cape Cod to the Arctic Ocean, North Atlantic to Norway and Spitzbergen.

(*b*) *In N. B. waters;*—Grand Manan, coralline zone, shelly bottoms, sparingly, *Stimpson,* (D). Bay of Fundy, four or five miles off the eastern end of Campobello, 100 to 125 fathoms, mud and broken shells, *Verrill,* (N). Gulf of St. Lawrence, abundant in 100 to 250 fathoms, as well as in shallow water, *Whiteaves,* (P).

This is a "Syrtensian" rather than an "Acadian" species, and hence rarely met with in our shallow waters. It has been very appropriately named "spinulosa," for both disk and arms fairly bristle with spines. The disk, which is from one-third to one-half an inch in diameter, is evenly covered both above and below with short, stout cylinders, each of which ends in a rounded crown of fine thorns. The mouth has six or seven papillæ to each of its angles. The arms are between four and five times as long as the diameter of the disk. The side arm plates are large, meeting both above and below along the whole length of the arm ; the upper arm-plates show a small triangular, and the lower a squarish or shield-shaped portion. Each side arm-plate bears about seven long, slender, tapering spines.

Nothing is known of the development of this species and almost nothing of its habits. It seems to prefer muddy and shelly bottoms, is never found above low-water mark, and lives only in cold, clear water.

4. **Amphiura squamata,** (DELLE CHIAJE), SARS. *Ophiolepis tenuis,* AYRES (*D*). *Amphipholis elegans,* LJUNGMAN (*Q*).

DESCRIPTION. (J) p. 121.

FIGURE. (F) pl. III. (*under name A. tenera*).

DISTRIBUTION. (*a*) *General ;*—Low-water mark to 120 fathoms. Almost cosmopolitan. New Jersey to the Arctic Ocean, Northern Europe to and in the Mediterranean, Cape of Good Hope, and Southern Pacific near Australia.

(*b*) *In N. B. waters;*—Grand Manan, among nullipores, below low-water mark, frequent, *Stimpson,* (D): Eastport, twenty fathoms, shelly bottom, sparingly, *Verrill,* (L), (N). Bay of Fundy, low-water to sixty fathoms, common, *Verrill,* (Q).

This is a very small but pretty and graceful Ophiuran. The disk, one-fifth of an inch in diameter, is covered with overlapping scales of about equal size, with a sharp line where those of the upper meet the projecting edges of those of the lower surface. The arms are about four-fiths of an inch long, slender and very flexible. The lower arm-plates are shield-shaped, the upper rounded and slightly separated by the encroachment of those of the side, which encroach more above than below. There are three short, blunt, nearly equal arm-spines to each side-plate, the upper of which is a little the stoutest. It is generally greyish in color, with occasional reddish markings, and found among broken shells, under which it hides itself. It possesses special interest from the fact that it is viviparous. If old individuals be opened in August they will be found to contain several orange colored young. The eggs being protected within the body of the mother, their development is without a metamorphosis.

This species has not yet been reported from the Gulf of St. Lawrence, but it ought to occur there, both in the deep and shallow parts, and will probably be found after further search.

5. **Ophiopholis aculeata,** (RETZIUS), GRAY. *Ophiopholis scolopendrica,* M. et T. (D). *Ophiopholis bellis,* LYMAN (J). [See Plate, Fig. 3.]

Daisy Serpent-star. Daisy Brittle-star.

DESCRIPTION. (A) p. 53, (J) p. 96.

FIGURE. (A) p. 53, (J) pl. I., (K), p. 115, (F) pl. II., (Q) Fig. 270, etc.

DISTRIBUTION. (*a*) *General*;—Littoral to 1,000 fathoms. South of 40° N. to Arctic Ocean, all around North Atlantic to the English Channel and Ireland, Spitzbergen, Alaska.

(*b*) *In N. B. waters*;— Grand Manan, laminarian zone, excessively common, *Stimpson*, (D). Eastport, low water to twenty fathoms, very common, *Verrill*, (L), (N). Bay of Fundy, very common, low water to 100 fathoms, *Verrill*, (Q). Abundant in pools on southern coast, *Ganong*, (X). Common in the Gulf of St. Lawrence, *Whiteaves*, (P).

This is by far the most abundant, most easily obtained and most beautiful and graceful of all our Ophiurans. It exists everywhere upon the southern coast, and may be found in large numbers about low-water mark by turning over stones and looking under ledges. Its disk, which is one-half to three-quarters of an inch in diameter, is pentagonal in shape, bulging out between the rays. It is closely beset above with short flattened spines except on the distinct primary and radial plates. On the under side the arms spring from near the mouth, of which the papillæ, six to each angle, and the teeth, are distinctly seen. The arms are three to four inches long in the largest specimens. The upper arm-plates are oval in form, each being surrounded by a row of small supplementary pieces, "seeming like a brooch set in a frame of gems," as Forbes says; one row, however, is common to two plates where the latter are adjacent to one another. Under arm-plates are squarish, side arm-plates inconspicuous, but each bearing about six arm-spines, so that there are about six on each side of each segment of the arm. There is the greatest variation in color, scarcely any two individuals being alike in this respect. Mottled with various shades of yellow, orange, red, green, almost every conceivable combination of patterns involving these colors may be found.

If one wishes to find them he must look in the most sheltered and rocky places, for they hide themselves away in all sorts of nooks and dark places. They are exceedingly graceful in their motions, having the power of moving their arms in every direction with sinuous snake-like ease and rapidity, showing well how the group received its name of Ophiurans or Snake-tails. They are greedily eaten by the cod, though one would think there could be but little nourishment in their hard bodies. In their development they pass through a complicated metamorphosis. The eggs are cast into the water, and after a series of changes result in a free swimming easel-shaped larva of complicated structure. From a portion of this, near the mouth, the young Ophiuran begins to form, absorbing the substance of the larva as it grows.

6. **Ophioglypha robusta,** (AYRES), LYMAN. *Ophiolepis robusta,* AYRES (D). [See Plate, Fig. 3*x*.]

DESCRIPTION. (J) p. 45, (U) p. 62.

FIGURE. (F) pl. I. [*under name Ophiura squamosa*], (U) pl. IV.

DISTRIBUTION. (*a*) *General;*—Low-water mark to 150 fathoms. Massachusetts Bay to Greenland, Arctic Ocean, Northern Europe, Alaska.

(*b*) *In N. B. waters;*—Grand Manan, low-water mark and laminarian zone, abundant, *Stimpson,* (D). Eastport, low-water to twenty fathoms, frequent, *Verrill,* (L), (N). East of Campobello, 100 to 125 fathoms, *Verrill,* (N). Gulf of St. Lawrence, "very sparingly met with," *Whiteaves* (P).

This species resembles somewhat *O. Sarsii,* but is much smaller and differently colored. The disk is one-third of an inch in diameter and covered above with regularly arranged and nearly equal scales. The mouth has seven papillæ to each angle. The arms are one and one-fourth inches long, tapering to mere threads. The upper arm-plates are diamond-shaped with rounded angles ; side arm-plates meet below but not above until half way out on the arm ; each bears three rounded, tapering, sharp spines, of which the upper is the largest. It varies greatly in color ; it may be grey, variegated with red or black, or brown or even blue. It lives either upon rocky or mud bottoms, seeming to prefer the former. Nothing is known of its habits or development.

7. **Ophioglypha Sarsii,** (LÜTKEN), LYMAN. *Ophiolepis ciliata,* MÜLL. et TROSCH. (D). [See Plate, Fig. 3*y*.]

One of the "Brittle-Stars."

DESCRIPTION. (J) p. 41, (U) p. 60.

FIGURE. (F) pl. I., (U) pl. IV.

DISTRIBUTION. (*a*) *General;*—Low-water mark to 1,600 fathoms. South of 40° N., to Greenland and Davis Strait, Northern Europe to Great Britain, Alaska.

(*b*) *In N. B. waters;*—Grand Manan, sixty fathoms, mud, *Stimpson,* (D). Eastport, large, not common, fifteen to twenty fathoms, stones, *Verrill,* (L), (N). Bay of Fundy to east of Campobello, 100 to 125 fathoms, *Verrill,* (N). Abundant on southern coast in ten fathoms, *Ganong,* (X). Very abundant and of large size in Gulf of St. Lawrence in 25 and up to 250 fathoms; Bradelle Bank, large and frequent, *Whiteaves* (P).

This species is quite common in our waters in from five to thirty fathoms. It is of a grey color above, lighter beneath. The disk, which is one-half to three-fourths of an inch in diameter, is circular in form and covered above with rounded plates of different sizes, among which may be distinguished one central surrounded by five others, and one on each side of the base of each arm. The mouth has thirteen papillæ to each angle and conspicuous mouth shields. The arms are three to four times as long as the diameter of the disk. Upper arm-plates are large; side arm-plates nearly cover the under, and each bears three spines, giving them a triple row on each side. It can only move its arms in the plane of the body, and in a stiff and ungraceful way, making with them a sort of oar-like motion, by which it propels itself over the mud on which it lives. Nothing is known of its habits. Its development is direct and it is viviparous.

[Prof. Verrill writes as this paper is in press, that in the Bay of Fundy "of Ophiurans, *Ophioglypha signata*, V., is common, and there are additional species of *Ophiacantha, Amphiura* and *Ophioscolex*."]

## Order II. ASTERIDEA (True Starfishes).

***Asteroidea whose arms are prolongations of the disk, containing appendages of the alimentary canal and also the generative organs, possessing a deep uncovered ambulacral groove, running along the ventral surface, in which the ambulacral feet are arranged in rows.***

### FAMILY ASTERIADÆ.

***With the cylindrical ambulacral feet ending in broad suctorial disks, and usually arranged in four rows along each ambulacral groove.***

8. **Asterias vulgaris,** Stimpson, Ms. *Uraster rubens*, Lin. Ag. (A). *Uraster violacea*, Müller. (A). *Asteracanthion rubens*, M. et T. (D). *Asteracanthion violaceus*, M. et T. (D). [See Plate, Fig. 4*].

"Starfish," "Five-finger," "Crossfish."

Description. (A) pp. 83 and 91, (L) p. 347, (S) p. 418.

Figure. (A) pp. 83 and 91, *American Naturalist*, Vol. II., pl. VI., Fig. 11.

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*Fig. 4 represents *A. Forbesii*, but as the characters which separate the species do not appear in a figure, it shows well the appearance of *A. vulgaris*.

DISTRIBUTION. *(a) General;*—Littoral to 208 fathoms, Long Island Sound to Labrador, European Seas [if identical with *A. rubens*].

*(b) In N. B. waters;*—Grand Manan, large and common, just below low-water mark, *Stimpson*, (D). Eastport and Grand Manan, abundant and large among rocks at low water, *Verrill*, (L). Eastport, *Verrill*, (N). Bay of Fundy, above low water mark to forty fathoms, very abundant, *Verrill* (Q). Passamaquoddy Bay, common everywhere, *Ganong*, (X). Shediac, on oyster beds, and other parts of the Gulf of St. Lawrence, *Whiteaves*, (P). Very abundant everywhere on the southern coast, and by far the most common species. At Bar Island, near the mouth of L'Etang harbor, particularly abundant and large.

A description of this species for purposes of identification is scarcely needed. It is typically *the* Starfish of our coasts and is abundant almost everywhere on the rocks in clear water. The five long rays with their short blunt spines, surrounded by rings of pedicellariæ, four regular rows of tube-feet, radiately-striated madreporic body and other characters of the species soon become familiar to the student. When adult it can be confounded with no other species upon our coast, though the identification of young specimens is not always easy. In color it is "usually reddish, purplish, or violet, varying to yellow and brown, but with a pale buff or cream-colored madreporic plate."* But the color and even the form of the animal varies with the sex, "season, state of the ovaries, age, dilation with water, etc." * The very large specimens found near the mouth of L'Etang harbor are either a pale purple, red, a cream color, yellow or a dull green. Verrill says (L) that in the Bay of Fundy it grows to be fifteen inches in diameter and upwards. The specimens at L'Etang, which are the largest the writer has seen, are a little over a foot in diameter.

The habits of this species can be easily studied. It is very hardy and will live for some time in glass vessels of water, and thrive under conditions which would quickly prove fatal to deep-water forms. In the tide-pools near low-water mark their method of locomotion, taking food, etc., may be readily seen, and in the glass vessels may be tried upon them many simple experiments which will readily suggest themselves to the earnest student.

Specimens are often found with only four, three, two, or even one perfect ray, and with the others either small or quite wanting. A careful search will usually show in the latter case the budding rudiments of the missing ones, which will soon grow to replace those which have been lost.

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* Verrill (S).

This very common species has unfortunately no economic value of any importance. The lime in its skeleton gives it sometimes a very limited value as a fertilizer. It is very injurious to oyster beds.

Its development is similar to that of *A. Forbesii;* there is a complicated metamorphosis, the larva (Brachiolaria) being free-swimming and bilaterally symmetrical.

[**Asterias Forbesii**, VERRILL. *Astracanthion berylinus,* AG. (K). [See Plate, Fig. 4].

DESCRIPTION. (K) p. 108, (L) p. 345, (S) p. 418, (T) p. 94.

FIGURE. (K) p. 110, (T) pl. IX.

DISTRIBUTION. *(a) General;*—Littoral to twenty fathoms. Casco Bay, Maine, to the Gulf of Mexico.

*(b) In N. B. waters;*—Not yet reported. [Verrill in 1866, (L), said:—"At Eastport, Me., and Grand Manan, it is very rare," but later he corrects this, (Q), "not known from the eastern part of the coast of Maine, nor in the Bay of Fundy." It is inserted here on account of the possibility of its occurring in the Gulf of St. Lawrence and to call attention to the necessity for a search being made for it there.]

In general, this species is very like *A. vulgaris.* The chief distinguishing characters are to be found, according to Prof. Verrill, (S), in the color, and form of the pedicellariæ and of the adambulacral spines. As to the color, "*A. Forbesii* is generally greenish, varying to orange and brown, with a bright orange madreporic plate; while *A. vulgaris* is usually reddish, purplish, or violet, varying to yellow and brown, but with a pale buff or cream-colored madreporic plate."

As to the other characters, Prof. Verrill says:—"In *A. Forbesii* the major pedicellariæ [*i. e.* the larger sessile pedicellariæ borne over the surface or on the ventral spines] are short, ovate, blunt-pointed, hardly longer than broad; the adambulacral spines are stout, obtuse and in most cases, many are more or less flattened and grooved externally at tip."

"In *A. vulgaris,* the major pedicellariæ are lanceolate, sharp-pointed, much longer than broad; the adambulacral spines are larger, more pointed and seldom flattened."

The characters, however, of most use to our collectors will doubtless be found to be, the greenish color of the animal and (particularly) the bright orange color of the madreporic plate.

In habits it is similar to *A. vulgaris.* Its development has been very carefully worked out by Alexander Agassiz. The eggs are cast out into the water, and after a series of changes result in a larva which is so different from the adult that its relationship was not for a time suspected, and it was described as a separate animal under the name of *Brachiolaria.* (See Plate, Fig. 5). Its appearance is well shown by the figure. It leads an entirely independent existence, taking and digesting food for itself and swimming freely about by means of a long band of vibratile cilia. The adult Starfish buds off from a point near the mouth and grows at the expense of the larva, gradually absorbing the substance of the latter as it increases in size.]

9. **Asterias littoralis.** (STIMPSON), VERRILL. *Asteracanthion littoralis,* ST. (D). [*Asterias Grœnlandicus,* STEENSTRUP (P).] *Leptasterias littoralis* (S).

DESCRIPTION. (D) p. 14.

FIGURE.

DISTRIBUTION. *(a) General;* — Between tide-marks to forty or fifty fathoms. Bay of Fundy and Gulf of St. Lawrence.

(*b*) *In N. B. waters;*—Grand Manan, "very common among the fuci in the middle region of the littoral zone, or even near high-water mark—elsewhere I have never found it," *Stimpson,* (D). "Eastport and Grand Manan, abundant from half-tide to low-water mark, among rocks and fuci," *Verrill,* (L), on the shores, (N). Gulf of St. Lawrence, *Whiteaves,* (P). [Mr. Whiteaves now considers the specimens mentioned in his reports under the name *A. Grœnlandicum* to belong to this species.]

This species is very appropriately named "littoralis," for it is one of the commonest of littoral forms. Stimpson (D), describes it as follows: "Body tumid, rays very broad. Ambulacral spines in two rows, slender, blunt, or even clavate at their tips. Spines on the sides larger than those on the back, but both short, blunt, and showing great uniformity in size and distribution. Its color is always a dark green above, and it never exceeds an inch and a half in diameter. It is very common among the fuci in the middle region of the littoral zone, or even near high-water mark—elsewhere I have never found it." Prof. Verrill in a letter to the writer says he has found it six to eight inches across, and in all depths down to forty or fifty fathoms. Nothing is known of its habits more than is indicated above, and we know nothing of its development.

10. **Asteracanthion Grœnlandicum,** LÜTKEN, (STEENSTRUP). *Asteracanthion Mulleri,* SARS. (D), *Asterias Grœnlandica,* STP. (L), [p. 357.]

DESCRIPTION. (U) p. 27.

FIGURE. (U) pl. II.

DISTRIBUTION. (*a*) *General;* — Low-water mark to eighty fathoms. Grand Manan, Gulf of St. Lawrence, Labrador, Discovery Bay (north of Smith Sound), Assistance Bay, S.W. Coast of Nova Zembla.

*(b) In N. B. waters;*—Grand Manan, off northern point of Duck Island, thirty fathoms, *Stimpson,* (D). Gulf of St. Lawrence, near Anticosti, *Verrill,* (L). [The specimens from the Gulf referred to in Whiteaves' various reports as belonging to this species are now considered by him to be *A. littoralis.*]

This rather small Starfish, though presenting no striking peculiarities to the eye, may nevertheless be readily distinguished from all other species. It is rarely or never more than two inches in diameter, and looks at first sight much like a young *Asterias vulgaris.* The spines upon the sides of the rays are arranged in more or less regular lines, and each is surrounded at its base by a nearly or quite complete ring of pedicellariæ. This ring of pedicellariæ around the base of the spines on the sides of the arms affords one of the best characters for distinguishing the species. The pedicellariæ also form a fringe along the sides of the ambulacral furrow. The ambulacral spines stand in three to four rows and are long and cylindrical. In color it is variable, being sometimes, as in Stimpson's specimens, bright red, and also greyish or olive-green. It seems to prefer rocky bottoms, but nothing is known of its habits or development.

11. **Leptasterias tenera,** (STIMPSON), VERRILL. *Asterias tenera,* STIMPSON (Proc. Bost. Soc. VIII.)

DESCRIPTION. Proc. Bost. Soc. Nat. Hist., Vol. VIII, 1861-62, p. 269.

FIGURE.

DISTRIBUTION. *(a) General;*—Cape Ann to Bay of Fundy.

*(b) In N. B. waters;*—"At Eastport, Me, in twenty fathoms, I have dredged several small specimens, about an inch in diameter, that appear to be referable to this species." Verrill (L).

This species is not at all common in our waters, but it possesses a special interest on account of the way it carries its young. The latter are attached to the parent near the mouth by a cord or umbilicus and there they live until able to shift for themselves, the development being without a metamorphosis.

It has usually five rays, which are slender but not contracted at base. The ambulacral furrows are deep, the tube-feet not forming four distinct rows. On the back, towards the disk, five longitudinal rows of spines may be distinguished, which become irregular towards the tips of the rays. The spines of both back and sides bear a small crown of minor pedicellariæ [*i. e.* the small pedunculated ones borne on the spines]. The madreporic plate is surrounded by a circle of spines and there are few or no major pedicellariæ. The papulæ or water-tubes of the back are placed singly and not in clusters as in *A. vulgaris.*

In color it is of a pale flesh color or white. It is about two and one-half inches in diameter. Nothing is known of its habits, and its development, as mentioned above, is direct.

[Prof. Verrill, in a letter to the writer, says :—"*A. compta*, St., I have from the Bay of Fundy, and I am inclined to think that *A. tenera* is only a slender variety of it." It is, however, left as a separate species in this paper, as Prof. Verrill has not published his comparisons of the two, and the writer has not been able to examine specimens of *A. compta.*]

[**Asterias (Leptasterias) Stimpsoni,** VERRILL (L).

DESCRIPTION. (L) p. 349.

LOCALITY. Eastport, Me., twenty fathoms, stony bottom, not common, *Verrill* (L).

Prof. Verrill now considers that this species was not well founded. He says, (S) :—"I have become satisfied that the species described by me as *A. Stimpsoni* in 1866, was not well founded. The study of a far more extensive series of specimens has shown that the specimens thus named were somewhat peculiar small specimens of *A. vulgaris* (Stimp.), with which some young specimens of *A. littoralis* were also confounded, so that the characters given largely appertain to the young of *A. vulgaris.*"]

12. **Stichaster albulus,** (STIMPSON), VERRILL. *Asteracanthion albulus*, ST. (D). *Stephanasterias albula*, V. (N). [See Plate, Fig. 6].

DESCRIPTION. (D) p. 14, (L) p. 351, (U) p. 29.

FIGURE. (D) pl. I., (U) pl. II.

DISTRIBUTION. (*a*) *General;*—Low water to 192 fathoms. South of 40° N. lat., Eastport and Grand Manan, Davis

Strait, Franklin-Pierce Bay (North of Smith Sound), Iceland, Spitzbergen, Öfjord.

*(b) In N. B. waters;*—Grand Manan, four or five fathoms, among branching nullipores on east side of the islands, quite abundant, *Stimpson,* (D), "Eastport, Me., and Grand Manan, in ten to twenty fathoms, rocky bottoms, and among nullipores; also frequent at low-water of spring tides among rocks," *Verrill.* (L), (N).

This curious Starfish is not uncommon on our coast, and may be easily recognized when found. It has nearly always six rays (only about two per cent having five), and three upon one side are usually much smaller than the three upon the other. It is generally quite small, not often exceeding one and one-half inches in diameter, though Verrill found a specimen at Eastport which was four inches across, and in a letter to the writer, he says he has since found it as large as six or eight inches across. The ambulacral furrows are very broad, and the tube-feet arranged in from two to four rows, according to age. The back and sides are covered with short spine clusters, which are so closely and regularly arranged as to give the animal a smooth appearance. Along the crest of each ray they are larger and more closely set than elsewhere so that there is a marked median line. There is a tuft of spines at the end of each ray.

In color it is faint red or cream color, Stimpson's many specimens being uniformly of the latter shade. It lives upon rocky bottoms, but nothing more is known of its habits, and nothing of its development.

*Var.* **nitida.**

[Verrill (L) established a new variety, *nitida,* from his large Eastport specimen, but that variety, he has since informed the writer, he now considers not well founded, his specimen being but a well developed individual of the species *albulus.*]

### FAMILY SOLASTERIDÆ.

*With the cylindrical ambulacral feet arranged in two rows, the rays often more than five.*

13. **Crossaster papposus (Fabricius),** MÜLLER and TROSCHEL. *Solaster papposa,* FORBES. (T), (D). [See Plate, Fig. 7.]

"Sun-Star."

DESCRIPTION. (A) p. 112, (T) p. 99, (U) p. 36.

FIGURE. (A) p. 112, (T) pl. XII., (U) pl. III.

DISTRIBUTION. (*a*) *General;* — Low-water mark to 610 fathoms. From Massachusetts Bay, northward to Smith Sound and all around the North Atlantic and Arctic Oceans to coasts of the British Islands and France, Spitzbergen and Barents Sea, and possibly Behring's Straits.

(*b*) *In N. B. waters;*—Grand Manan, rare and small on shelly bottoms in corralline zone, *Stimpson*, (D). Bay of Fundy, not uncommon, low water to forty-five fathoms, rocky bottoms, *Verrill*, (L). Eastport, low water to fifteen fathoms, *Verrill*, (N). Pendleton's Island, on reefs; L'Etang, fine specimens, stony bottoms, *Ganong*, (X). Bradelle Bank and deeper parts of Gulf of St. Lawrence, *Whiteaves*, (P).

This is one of the most beautiful and attractive of all our Starfishes, being rivalled in these respects only by the "Cushion-Star," (***Goniaster phrygiana***). Its many regularly-radiating symmetrical rays, its pretty tufts of brush-like spines which cover its upper surface, and its always bright and often variable colors, are features which give it pre-eminence among its kindred.

It grows sometimes to a diameter of eleven inches, though it commonly is not more than from four to six. It may have any number of rays from ten to fifteen (though most frequently there are eleven, twelve or thirteen), each of which is flattened, tapers uniformly from base to tip and is equal in length to from one-half to the whole diameter of the disk. The ambulacral furrows are broad and contain two rows of tube-feet. The spinulation of this species is peculiar and very characteristic. The animal seems at first sight to be almost covered with tufts of slender spines, but a little study shows that they may all be referred to a few simple systems. All over the limestone network of the upper surface, both on arms and disk, are prominent club-shaped processes (running approximately in lines on the arms, but scattered irregularly on the disk), each of which bears on its summit a brush-like tuft or group of from eighteen to thirty slender articulated spinelets, which are about as long as the clusters are far apart. Upon the under surface, on each side of the ambulacral furrows, there occur two series of these clusters, both having all the spines of each single cluster in one plane. But the inner row, with its three to four spinelets to a cluster, has the plane of all the clusters parallel to the longitudinal axis of the furrow, while the outer row, having five to seven spinelets to a cluster, has the planes of these clusters at right angles to that axis. The inner series afford a protection to the furrow, being quite long enough to cover it when extended to meet from the two sides. The mouth plates, capping the inner angles where the rays meet, are large and sub-triangular in form and each bears a marginal fringe of large strong spines, forming powerful mouth-papillæ.

One of the most marked characters of the species is its always bright though often variable coloration, which varies with the sex. The fine specimens from L'Etang harbor are all a uniform brilliant red, which is said to be the case with those from Greenland. At other localities it occurs mottled with lighter shades, even to white and straw color, or of various shades of purple. Forbes tells us of specimens with the disk red, the arms white, tipped with red, and of another found by himself in which the body was red and the spiniferous tubercles bright green. Prof. Alexander Agassiz says that it sometimes has bands of red and purple arranged concentrically, and that there occur all shades between a brilliant red and a light orange or a dark violet. When young they are usually nearly white.

*Crossaster* lives always upon hard bottoms, in clear, cold water. It is said to be very voracious, living upon various molluscs, and to be occasionally injurious to oyster beds. Nothing whatever is known of its development.

14. **Solaster endeca,** (GMELIN), FORBES. [See Plate, Fig. 8.]

"Purple Sun-Star."

DESCRIPTION. (A) p. 109, (T) p. 112, (U) p. 40.

FIGURE. (A) p. 109, (T) pl. XVII., (U) pl. III.

DISTRIBUTION. (*a*) *General*;—Low-water mark to ninety fathoms. Massachusetts Bay northward to Davis Strait and around the North Atlantic to the British Islands and France. Also Sitcha and Alaska.

(*b*) *In N. B. waters*;—Grand Manan, abundant on rocks at low-water mark, small; large individuals, a foot in diameter, laminarian zone, *Stimpson*, (D). Bay of Fundy, low-water to twenty fathoms, *Verrill*, (L). Eastport, low-water to fifteen fathoms, *Verrill*, (N). Pendleton's Island reefs, and Bar Island at the mouth of L'Etang harbor, *Ganong*, (X). Gulf of St. Lawrence, *Whiteaves*, (P).

Upon our coast this Starfish is usually found in the same localities and very frequently associated with *Crossaster papposus*, though it prefers perhaps somewhat shallower water. At first sight it would seem to be closely allied to the latter species, and indeed was for a long time placed in the same genus with it, but a closer study shows that the two have little in common beyond the number of the rays. It is more nearly related to *Cribrella sanguinolenta,* which, except for the difference in the number of the rays, it closely resembles.

It has been found even in our own waters as large as twelve inches in diameter, but most specimens would not much exceed half that size. It may have from seven to eleven rays, ten being perhaps the most common number. Each ray is nearly round in section, tapers evenly from base to tip, and is about as long as, or a little longer than the diameter of the disk. The ambulacral furrows, containing each two rows of tube-feet, are narrow and can be completely closed in by the bringing together of the edges of the furrow. The madreporic body lies about half way between the centre of the disk and an angle of the rays. The spinulation is not unlike that of *Cribrella* and differs considerably from that of *Crossaster,* in comparison with which it has quite a smooth appearance. The upper surface of both disk and rays is nearly covered with short blunt tubercles, each of which bear a crown of from five to ten short, rough, blunt spines, so small as to need a lens to properly distinguish them. These are scattered irregularly over the disk, but on the arms run in rather regular rows obliquely from the margin to the median line. On the under side are conspicuous rows of two kinds of spine-clusters, both of which kinds are flattened in a plane at right angles to the length of the ray. One of the rows, in which the clusters are made up of many slender, short spines united together at their bases, occupies all the outer margin of each ray, and curving evenly around the angle between any two coutiguous ones shows no breaks between the marginal rows of the arms. This row therefore forms a band around the entire margin of the under side, with the exception of a minute break at the tip of each ray. A row of much smaller clusters follows this on its outer side throughout its course, but is upon the sides of the rays rather than on their under surfaces. The other conspicuous rows are those which start near the mouth and run along each side of each ambulacral furrow to the tips of the rays. The clusters are made up of much longer and stouter spines than the former row, some six or seven in number, united at their bases and placed all in one plane, which is as already stated at right angles to the length of the ray. Another row, consisting of a line of single spines, may be seen quite within the ambulacral furrow. The remainder of the under surface contains clusters of larger spines than those of the upper surface. The mouth plates are large and strong and bear several stout spines, which form powerful mouth-papillæ.

In color it varies much, though not to such a degree as *Crossaster* or *Cribrella.* Above it is usually some shade of purple or red, and below of a straw or cream color, and the color varies with the sex. In our waters the upper side is nearly always purplish red and the under light orange.

It lives upon rocky or other hard bottoms in clear water, and in its habits seems to be much like *Crossaster*. Its development is entirely unknown, though from its relationship to *Cribrella* it is not improbable that it will be found to be viviparous.

15. **Cribrella sanguinolenta,** (O. F. MULLER), LÜTKEN.
*Linkia oculata*, FORBES, (D). *Linkia pertusa,* (D). *Cribrella oculata,* (LINCK), FORBES, (U). [See Plate, Fig. 9.]
"Eyed Cribrella."

DESCRIPTION. (A) p. 100, (K) p. 112, (T) p. 113, (U) p. 32.

FIGURE. (A) p. 100, (K) p. 112, (T) pl. XVIII., (U) pl. II.

DISTRIBUTION. (*a*) *General ;*—Low-water mark to 194 fathoms. Long Island Sound to Waigat Strait on the West Coast of Greenland. Around the North Atlantic and Arctic Oceans to Great Britain and the English Channel. Spitzbergen, White Sea, Sea of Ochhotsk, Alaska.

(*b*) *In N. B. waters ;*—Grand Manan, low-water mark to thirty fathoms on rocks, *Stimpson,* (D), *Verrill* (L). Eastport, low water to twenty-five fathoms, abundant, *Verrill,* (L), (N.) Bay of Fundy, low water to 100 fathoms, very common, *Verrill,* (Q). Shediac, on the oyster beds ; deeper parts of Gulf of St. Lawrence, *Whiteaves,* (P). Abundant everywhere in the sheltered harbors of the southern coast.

This species cannot be mistaken for any other upon our coast. It is the only one of the five-rayed (not pentagonal) Starfishes which has but two rows of tube-feet to each ray—all others having four. Its smooth appearance and bright colors are also characteristic, and these features, together with its rather graceful form, make it a very pretty Starfish.

In size it varies greatly. Upon the shores at low water specimens occur of from the smallest size up to one inch in diameter. In deeper water they grow much larger. The largest of which the writer has been able to find any record is one found by Sars on the coast of Norway, which was a little over six and one-half inches in diameter, and another mentioned by Forbes, seven inches in diameter. But the writer has in his collection two specimens dredged in L'Etang harbor in the summer of 1886, one of which was ten and the other eight inches in diameter when alive ; even in the dried state the former is a little over nine and the latter seven and one-half inches in diameter. Specimens five or six inches in diameter are not rare in our waters.

There are usually five rays, though very rarely six or seven-rayed forms may be met with. The proportional size of the length of the rays to the diameter of the disk varies greatly according to the size, and therefore, in a general way, according to the age of the animal. In specimens less than one inch in diameter the length of the ray is less than twice the diameter of the disk. In a specimen four inches in diameter, the ray is nearly three times as long as the diameter of the disk, while in the very large specimens above mentioned it is nearly three and a half times. The rays taper evenly from base to tip, except in the breeding season, when they are enlarged at the base. The ambulacral furrows are narrow and can be completely closed in by the bringing together of their sides.

Its spinulation is quite simple. To the naked eye the whole of the upper and the most of the under surface present a uniformly granular appearance. A good lens, however, will show that these granules consist in reality of clusters of spines borne upon low tubercles. But the clusters vary greatly as to the number, shape and size of the spines on different parts of the surface of the body. Among the spine-clusters may be seen in dried specimens little holes, which in the living animals may be seen to be occupied, each by a delicate projection of a clear membrane from the interior of the body. These are the papulæ or water-tubes, the function of which is not certainly known, but is supposed to be respiratory. It is the dotted or "eyed" appearance presented by these organs which is supposed to have suggested to Linck the name *oculata* which he gave to it and which is still used by some naturalists. Upon the under surface the spine-clusters grow somewhat larger as they approach the ambulacral furrows. Upon each side of the latter there runs from the mouth to the tip of the ray a row of clusters, flattened at right angles to the length of the ray, of very much larger spines ; these spines are arranged in the cluster in a double row and are largest on the edge of the furrow, growing rapidly smaller away from it. Inside of this row, indeed quite within the furrow, is another row of apparently single spines. The mouth-plates are rather small and the spines they bear not appreciably larger than those along the ambulacral furrows.

In color *Cribrella* varies greatly, but is always bright. The under side is usually light yellow or straw colored, and the upper some shade of red or purple, or even yellow or orange. These colors, as in other Starfishes, are more or less due to differences of sex. In the case of the two large specimens above mentioned, found at L'Etang, the larger, which proved upon dissection to be a male, was a dull purplish red above, and the smaller, a female, a bright orange. Prof. Alexander Agassiz expresses the variation in this species very vividly when he says: "This pretty little Starfish presents the greatest variety of colors; some are dyed in Tyrian purple, others have a paler shade of the same hue, some are vermilion, others a bright orange or yellow. A glass dish filled with *Cribrellae* might vie with a tulip-bed in gayety and vividness of tints."

**Our *Cribrella* lives upon the rocks and seaweeds about low-water mark, and on hard bottoms in deeper water. In moving, Prof. Agassiz points out (K) that it usually has three rays extended before it and drags the other two closely pressed together behind. In its development from the egg it passes through no free-swimming larval stage, but directly into the adult form. The young are carried about by the mother.**

### FAMILY ASTROPECTINIDÆ.

*With the ambulacral feet conical, without suctorial disk, and arranged in two rows.*

16. **Hippasteria phrygiana,** (PABELIUS), GRAY. *Goniaster equestris,* GMELIN, (A). *Goniaster phrygiana.* (D). [See Plate, Fig. 10.]

"Knotty Cushion-Star." "Cushion-Star."

DESCRIPTION. (A) p. 125, (K) p. 113.

FIGURE. (A) p. 125.

DISTRIBUTION. (*a*) *General;*—30 to 150 fathoms. Cape Cod northward to Arctic Ocean. Northern Europe and Great Britain.

(*b*) *In N. B. Waters;*—Grand Manan, off Duck Island in coralline zone, one specimen, *Stimpson,* (D).

This, says Stimpson, is "by far the most elegant of our Starfishes"; and Forbes calls it one of the most beautiful of the Starfishes of Britain. It is a pentagonal form and grows to be from nine to ten inches in diameter. The upper surface is covered with short, smooth spines, each of which is borne on the centre of a nearly circular plate. Around the margin of the upper surface there run two rows of plates which bear from one to three short spines. Along the ambulacral furrows are rows of spines arranged in pairs. In color it is generally bright red above and yellow beneath. Stimpson (D), thus describes his specimen:—"A large specimen was taken off Duck Island, in the coralline zone. It was bright red above, and bright yellow below, being by far the most elegant of our Starfishes. The minute vesicles which protrude from the dorsal pores are short and tipped with black. The eyes are very dark red in color, and the suckers near them are very long and slender, especially a single one just above each eye."

Very little of its habits and nothing of its development are known.

17. **Ctenodiscus crispatus,** (RETZIUS), DÜBEN and KOREN. *Ctendiscus corniculatus,* (LINCK), PERRIER, (U). [See Plate, Fig. 11.]

DESCRIPTION. (K) p. 113, (U) p. 49.

FIGURE. (K) p. 114, (U) pl. III.

DISTRIBUTION. (*a*) *General;*—Twenty-five to three hundred and twenty-one fathoms. South of Cape Cod, Bay of Fundy, Newfoundland, West coast of Greenland, Melville Island and Assistance Bay, Arctic Ocean, Spitzbergen, Barents Sea, Finmark, Scandinavian coast.

(*b*) *In N. B. waters;*—Grand Manan, fifty and sixty fathoms, muddy bottoms, not rare, *Stimpson,* (D). Beaver and Bliss harbors, mud bottoms, *Ganong* (X). Gulf of St. Lawrence, one of the most characteristic asterids of the greatest depths, *Whiteaves,* (P).

This is the most common of our three pentagonal Starfishes, and though dull in color is made attractive by its shape, curiously arranged marginal plates and unusual spinulation. In all of the pentagonal, as distinguished from the rayed Starfishes, the rays are much shorter than the diameter of the disk, and merge so gradually into it and into one another that the whole animal reminds one of a disk with five rounded lobes cut from its edge, rather than of a disk with five rays springing from it.

It sometimes attains to a size of over two and one-half inches across, but few specimens will exceed two inches. The rays are always five in number, about three-fourths of the diameter of the disk in length, and have the angles between them so well rounded that a very regular curve runs from the tip of each ray to the tip of its neighbor. The ambulacral furrows are rather broad, and each contain two rows of stout tube-feet, which, instead of being provided at their extremities with sucking disks, as in most of our Starfishes, are simply pointed. The upper surface of the disk, which in living specimens is usually swollen out, but in those which have been dried, very flat and somewhat depressed, is bounded all around by the upper ends of the marginal plates. It is almost completely covered by club-shaped processes or tubercles, each of which bears on its summit five to ten upright, rounded spines, so small as to be just visible to the naked eye. So uniform in size are these processes, with their flat tops and spine clusters, and so evenly and closely together are they placed, that their upper ends seem at first sight to form the upper surface itself of the animal. Near one angle is the madreporic body, and in the very centre of the disk is a conical projection, which is without function in the adult, but represents the remnant of the umbilical stalk by which the young are attached to the mother.

The marginal plates consist of two series, an upper and a lower. Each of the former is armed with a short, flattened spine, which points upwards. In the lower series, each plate is united with a corresponding one of the upper series, the line of junction being just above the row of flattened spines seen below the upper marginal row above described. Between each pair is a deep furrow which is continued on until it meets the ambulacral furrow, thus dividing up the under surface of the animal into bands which are seen to be covered with irregular scale-like plates. The ends of these bands, where they meet the ambulacral furrows, are formed by plates which bear each five or six short spines, the largest of which, about three in number, stand immediately on the margin of the ambulacral furrow, with the others behind them. The mouth plates are ovoid masses, bearing each nine mouth papillae and three to five nearly as large spines.

That this Starfish is low structurally, is shown by the fact that it, when adult, presents features which occur in the embryonic condition of other forms. The pentagonal form, pointed and suckerless tube-feet, and structure of the spines are all of this nature.

In color it is dull, being usually of a light brownish or drab color, sometimes varying to dull brownish-red. The specimens taken in our waters seem to be of a dull greyish-brown. It seems to inhabit mud bottoms almost exclusively, and prefers considerable depths. Nothing further is known of its habits. Its development is direct, the young being attached by an umbilical stalk to the mother.

18. **Pteraster militaris,** (O. F. MÜLLER), MÜLLER and TROSCHEL. [See Figs. 12 and 12*a*].

DESCRIPTION. (U) p. 46.

FIGURE. (U) pl. III.

DISTRIBUTION. (*a*) *General;*—Twenty to one hundred and fifty fathoms. Bay of Fundy, northward to Smith Sound. Spitzbergen, Finmark, Norway.

(*b*) *In N. B. waters;*—Hake Bay, Grand Manan, thirty-five fathoms, shelly bottom, three specimens, *Stimpson*, (D). Eastport Harbor, west of Treat's Island, ten to fifteen fathoms; between Razor Island and Lubec, eight to ten fathoms, *Verrill*, (N). Orphan Bank, somewhat plentiful, and deeper parts of Gulf of St. Lawrence, *Whiteaves*, (P).

. This Starfish is one of the most interesting upon our coast, and unfortunately is not at all common. It is pentagonal in form, much arched above, and about two inches in diameter, though specimens four inches in diameter have been found. All around the outer lower edge of the rays runs a narrow fin-like web, and the whole upper surface is covered by a membranous skin which is supported upon the extremities of the spine clusters. This skin, therefore, covers the upper surface of the body as a tent with many poles covers the earth, and in the covered space thus formed the ova are protected and the young develop. Upon the under side there are peculiar spine-clusters along each side of the ambulacral furrows.

Connected to near their tips by a web or membrane are five or six long spines, lying all in one plane at right angles to the length of the ray, the outermost of which is much the largest. These large outer spines are connected together by and form the support of the web already mentioned, which runs all around the rays. In color it varies from brick red through flesh-color and yellowish white to pure white. Nothing is known of its habits, and there is still much to be learned about its development, though it is known that the young live in the pouch formed by the skin of the back, and develop without a metamorphosis.

[In addition to the above species Prof. Verrill tells the writer that he has from the Bay of Fundy, *Asterias compta*, St., a second species of *Pteraster* of small size, a small *Asterina*, and, he believes, *Solaster furcifer*, and probably others.]

## Class III. ECHINOIDEA (SEA-URCHINS).

*Spherical, heart-shaped, or disk-shaped Echinoderms with immovable skeleton, made up of calcareous plates, enclosing the body like a shell and carrying movable spines, and with locomotive and often respiratory ambulacral appendages.*

### Order I. CIDARIDEA (REGULAR SEA-URCHINS).

*Echinoids with central mouth and equal band-like ambulacra.*

### FAMILY ECHINIDÆ.

*With a round thin shell, broad ambulacral spaces bearing tubercles and spines, the pores grouped in transverse rows; oral branchiæ present.*

19. **Strongylocentrotus dröbachiensis.** (MÜLLER), A. AGASSIZ. *Echinus granulatus*, SAY, GOULD. (D). *Toxopneustes Dröbachiensis*, (K). *Euyechinus Drobachien-*

*sis*, VERRILL. (L). *Euryechinus granulatus*, VERRILL. (L). *Echinus Drobachiensis*, MULL. (P). [See Plate, Fig. 13].

"Sea-Urchin," "Sea-Egg," etc.

DESCRIPTION. (K) p. 101, (O) p. 277, (U) p. 19.

FIGURE. (K) p. 102, (O) pl. X., (Q) pl. XXXV., (U) pl. II.

DISTRIBUTION. (*a*) *General;*—Littoral to 640 fathoms. Circumpolar. From Great Britain and Norway, all around the North Atlantic and down the American coast to New Jersey. North Pacific from Kamtchatka to Alaska and Vancouver Island.

(*b*) *In N. B. waters;*—Reported from St. Croix (now Dochet) Island in 1604 by Champlain. (*Voyages du Sieur de Champlain, Paris, 1613*). Grand Manan, low-water to half a fathom, very common. "In this zone, these animals are so crowded together that it is impossible in most places to thrust an oar to the bottom without striking some of them," *Stimpson*, (D). Eastport, littoral to twenty fathoms, very abundant, *Verrill*, (L), (N). Bay of Fundy, low water to 109 fathoms, very abundant, *Verrill*, (Q). Passamaquoddy Bay, very abundant, *Ganong*. (X). Shediac, Gulf of St. Lawrence, *Whiteaves*, (P.) Exceedingly abundant everywhere upon the southern coast. Up the St. Croix River as far as the Devil's Head. Manawoganish Island, near St. John.

The common Sea-Urchin is the most abundant, best known and most easily recognized of all our Echinoderms. It cannot be confounded with any other animal upon our coast, though the writer has known it to be mistaken for a plant! In form it is somewhat hemispherical, with the flat side resting upon the ground, while the dead shell denuded of its spines may be likened in shape to an old-fashioned, smooth door-knob.

The largest specimens are four inches in diameter, including the spines, which are from one-half to three-fourths of an inch long. The latter, which are green in color, are attached to the shell by a ball and socket joint, and among them may be seen the ten meridional bands or zones of greatly extensible purplish tube-feet (each terminating in a sucking disk) which serve both for taking small prey and for locomotion. It can move but slowly and lives upon all sorts of bottoms, from mud to rock, from between tide marks down to considerable depths. It feeds upon both animal and vegetable food. With its five sharp teeth, the tips of which can be seen in the centre of its under side, it browses or grazes, according to Sir William Dawson,* along the bottom upon confervoid sea weeds, diatoms, sponges, and even in places the garbage of the fisheries. It is quite variable, both in the form of the shell and the shape and color of the spines, the latter varying from violet even to dull white. The dead specimens so frequently found upon the shore, either cast up by the waves or carried up by the crows, show as perfectly as the most carefully prepared specimen the instructive and beautiful structure of the shell itself, and but little skill is needed to dissect out the internal organs.

Some Sea-Urchins have the power of excavating hollows in the solid rock, in which they live. It is not known how they do so. This is, however, not done by our species, though in exposed situations they may be found occupying any natural hollows or crannies. In the soft conglomerates of parts of Passamaquoddy Bay they are sometimes to be seen in hollows which at first sight appear to be excavated by them, but careful examination generally shows that the hollows are left by the falling out of large pebbles from the soft matrix. Nor is our species of any great value as food, though this must be the species referred to by Dr. Stimpson (see p. 20 of this paper) as edible and as good as lobsters when boiled. A Mediteranean species is extensively eaten in Italy, and from being cooked by boiling and eaten from the shell as eggs often are, has given rise to its common name of Sea-Egg.

The course of its development from the egg is very well known. It has a larval stage (the Pluteus) which bears no resemblance to the adult. The larva has eight very long slender arms supported by calcareous rods, and a band of vibratile cilia, which assist it in swimming freely about. In about twenty-three days the Sea-Urchin begins to bud off from around the mouth of the larva, and as it grows the latter gradually disappears, being absorbed into the body of the adult.

## Order II. CLYPEASTRIDEA (SHIELD-URCHINS).

*Irregular Echinoids compressed to a shield form, with the mouth central and furnished with teeth; very broad ambulacra, a five-leaved ambulacral rosette upon the upper side; very small tube-feet.*

### FAMILY CLYPEASTRIDÆ.

*With the edge of the disk without deep indentations.*

20. **Echinarachnius parma,** (LAMARCK), GRAY. *Echinarachnius Atlanticus,* GRAY (D). [See Plate, Fig. 14].
"Sand-Dollar," "Cake-Urchin."

DESCRIPTION. (K) p. 106, (O) p. 316.

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* ("American Naturalist," I., 1867, p. 124.)

FIGURE. (K) p. 107, (O) pl. XI*e*, (Q) pl. XXXV.

DISTRIBUTION. (*a*) *General*; — Low-water mark to 888 fathoms. Almost cosmopolitan. Atlantic coast of North America from New Jersey to Labrador. Both sides of the Pacific Ocean. Australia, and possibly the Red Sea and India.

(*b*) *In N. B. waters;* Grand Manan, low water on sandy shores, very common, *Stimpson*, (D); Eastport, low water, *Verrill*, (N); Chamcook harbor and Hospital Island, abundant, *Ganong*, (X); Shediac and Gulf of St. Lawrence, *Whiteaves* (P). Abundant on southern coast almost everywhere in sand just below low-water mark.

This Echinoderm is almost described, in so far as its general appearance is concerned, by its two English names alone. In outline it is nearly circular, is quite flat upon its lower side and only gently convex upon its upper, being in profile not unlike a strung bow. It grows to a diameter of three inches, is reddish brown in color and covered with crowded very short slender spines which make it appear, when first taken from the water, as if covered with velvet. The dead and bleached shells sometimes found upon the shore but easily prepared, show the plates of which it is made up and their homologies with those of the common sea-urchin, together with the distribution of the short ambulacral feet. The latter are confined upon the under side to five radiating furrows which branch towards the ends. Upon the upper side they are modified and enlarged to form branchial or gill-like appendages, and the pores through which they pass are arranged in a regular rosette of five petals, which is very conspicuous in the dead shell. The teeth are not visible externally, though they may be seen through the spines which protect the mouth.

The Cake-urchin lives always upon sandy bottoms and usually in shallow water. It creeps along very slowly by means of its many tube-feet just beneath the surface of the sand or half covered by it, feeding upon the minute organisms, both animal and vegetable, which the sand contains. It is itself eaten by some fishes, especially flounders. It has, according to Prof. Verril (Q), a certain limited direct value to man. "The fishermen on the coast of Maine and New Brunswick sometimes prepare an indelible marking ink from these 'sand-dollars', by rubbing off the spines and skin, and, after pulverizing, making the mass into a thin paste with water." It is always an interesting form to all who chance to meet with it, on account of its shape and pretty markings.

In its development it passes through a metamorphosis similar to that of the ordinary sea-urchin, having a Pluteus not unlike the latter. [See Plate, Fig. 14*a*.] From a point near the mouth the adult sea-urchin buds off, gradually absorbing the substance of the Pluteus as it grows.

## **Order III. SPATANGIDEA** (HEART-URCHINS).

*Irregular Echinoids more or less heart-shaped, with eccentric mouth, no teeth, and usually a four-leaved ambulacral rosette.*

### FAMILY SPATANGIDÆ.

21. **Schizaster fragilis,** (DÜBEN AND KOREN), AGASSIZ.

One of the "Heart-Urchins."

DESCRIPTION. (O) p. 363.

FIGURE. (O) pl. XXI.

DISTRIBUTION. (*a*) *General;*—80 to 321 fathoms. Straits of Florida, Bay of Fundy, Gulf of St. Lawrence, Lofoten Islands, Norway.

(*b*) *In N. B. waters;*—Centre of the Bay of Fundy, east of Grand Manan, 95 to 106 fathoms, *Verrill,* (R). Deep parts of Gulf of St. Lawrence, "widely distributed in the deep-sea mud," *Whiteaves,* (P).

This fine Sea-Urchin is a member of the Syrtensian and not of the Acadian Fauna, and is hence not likely to come into the hands of many of our collectors. It is the highest in organization of our Echinoids, a fact which impresses the observer at a first glance, for the radial symmetry is disguised so that its bilateral symmetry, showing a differentiation from the typical radiate towards a higher type, first strikes the eye.

In outline it is round heart-shaped, a little more than half as high as long. Large specimens are two and one-half inches in length, but the average is rather smaller. It is covered with short (one-eighth to one-fourth of an inch), slender brownish spines, which are largest about the branchial rosette. The latter is not regular as in the Cake-Urchin, the three anterior petals being much larger than the others. Running around the rosette and close to the tips of the petals is a line, the fasciole, which bears, not spines, but minute ciliated bristles. The mouth is not placed in the centre on the under side as in our other two forms, but near one end, where the shell forms a prominent lip to protect it. Owing to its eccentric position the ambulacral grooves radiating from it are of unequal lengths.

It lives chiefly upon muddy bottoms, but nothing further is known of its habits. There is some uncertainty about its development, but it is believed to pass through a metamorphosis somewhat similar to that of Strongylocentrotus, with a free-swimming larva or Pluteus.

## Class IV. HOLOTHUROIDEA (HOLOTHURIANS).

*Worm-like, elongated Echinoderms, with a leathery body-wall, and contractile tentacles surrounding the mouth.*

### Order I. PEDATA.

*Numerous ambulacral feet, sometimes arranged in the meridians and sometimes distributed over the whole surface.*

#### FAMILY DENDROCHIROTÆ.

*With tree-like branched tentacles, and the ambulacral feet arranged in regular rows, or confined to one side, which becomes a walking disk.*

22. **Psolus phantapus,** (STRUSSENFELDT), JAEGER. *Psolus laevigatus*, (C). [See Plate, Fig. 15.]
"Snail Sea-Cucumber."

DESCRIPTION. (A) p. 203. (C) pp. 25, 36. (N) p. 342.

FIGURE. (A) p. 203.

DISTRIBUTION. (*a*) *General;*—Low water to eighty-six fathoms. Coast of Maine, Grand Manan and Greenland, and around the North Atlantic to Scandinavia and the British Isles.

(*b*) *In N. B. waters;*—Grand Manan, forty fathoms, common, attached to small stones; Eastport, one specimen, very large, from six inches deep in gravel, *Stimpson*, (D). Eastport, young, adult rare, *Verrill*, (N). Gulf of St. Lawrence, Orphan and Bradelle Banks, *Whiteaves*, (P).

This species resembles in a general way *Lophothuria Fabricii*, but presents characters by which it may readily be distinguished from it. It is of smaller size than the latter species, rarely, in our waters at least, attaining a length of three inches, though Forbes (A), says it grows to be six or eight inches in length. The flattened under side is quadrangular in outline and has three distinct and parallel bands, each of two rows, of large and strong tube-feet, connected by a few scattering ones at the ends. The plates are arranged much as in *L. Fabricii*, but are much smoother, having few granules. Upon the upper side may be seen two longitudinal depressions of the skin and plates, representing the position of two rows of tube-feet. It is of a brownish color.

It lives in situations somewhat similar to *L. Fabricii*, but prefers in general deeper water, and is often found in the stomachs of fishes. But little is known of its habits, and nothing of its development.

23. **Lophothuria Fabricii,** (DÜBEN and KOREN), VERRILL. *Cuvieria Fabricii,* DÜB. et KOR., (D). *Psolus Fabricii,* (D. and K.), LÜTKEN, (U).

"Sea-Orange." [See Plate, Figs. 16, 16*a*.]

DESCRIPTION. (K) p. 98. (C) p. 35. (U) p. 10.

FIGURE. (K) p. 98. (U) pl. I. Emerton's "Life on the Sea-Shore," p. 137.

DISTRIBUTION. (*a*) *General;*—Low water to eleven hundred and sixty-eight fathoms. South of Cape Cod to Newfoundland and Greenland. Alaska. East of Nova Zembla (?)

(*b*) *In N. B. waters ;*—Grand Manan, abundant but small, among nullepores in five fathoms; above low-water mark, under shelving rocks, very large, *Stimpson,* (D). Grand Manan, common in two to eight fathoms, in a few localities adhering firmly to rocks, *Verrill,* (L). Eastport, young common, adult rare, on ledges, *Verrill,* (N). Bar Island, Bliss Harbor, large and abundant, *Ganong,* (X). Gulf of St. Lawrence, near Percé and between Pictou Island and Cape Bear, P. E. I., *Whiteaves,* (P).

The common name by which the allied *Psolus phantapus* is sometimes known, the "Snail Sea-Cucumber," would apply equally well to and describe the appearance of this species also. At first sight it seems to have nothing in common with the Holothurians, resembling rather a large snail, or, even more closely, a huge nudibranch mollusc. In it, bilateral symmetry is prominent and completely disguises the radial. The animal is arched above, and flattened below to form a disk, the outline of which is oval in shape and sharply defined. Fig. 16*a*. Upon it are borne three bands of tube-feet (the other two being aborted and their places covered by the plates of the upper side), one band, four or five rows deep, following each long curve of the oval disk, and the third, almost aborted, but showing traces of its presence on the median line, on the long diameter of the disk. The entire dorsal surface is covered by large overlapping calcareous plates, each of which is covered with granules, and presents its rounded free edge towards the median line of the back. In the region of the apertures, however, they are arranged around the latter as centres. The tentacles can be greatly extended, even to the length of the body itself, are ten in number, very much branched, and supported upon a soft ring. When extended they are of extreme beauty, and comparable, as Mrs. Agassiz says, "for richness of tint, and delicate tracery, to the most beautiful sea-weeds," (K). The animal varies from two to four inches in length, and is always of a red color, which varies from bright to dull brick-color. If placed in a glass vessel full of water, it will expand its tentacles and present a most beautiful sight. It lives among rocks at low and in shallow water, clinging to the under sides of ledges or in crevices between stones. In their development they pass through a free-swimming stage in which the bright red pear-shaped larva, having a circle of five tentacles at one end of the body and two at the other, moves by means of many cilia on different parts of the body. [See Plate, Fig. 16*b*.]

24. **Thyonidium productum,** (AYRES), STIMPSON. *Duasmodactyla producta*, (C).

DESCRIPTION. (C) p. 244.

FIGURE.

DISTRIBUTION. *(a) General;*—Bay of Fundy.

*(b) In N. B. waters;*—Eastport, rare, *Ayres*, (C); under stones at low water, not common, *Verrill*, (L); rare, (N). Grand Manan. "This species is found in deep water, but occurs most frequently under stones, or buried to a slight depth in gravel near low-water mark," *Stimpson*, (D).

This rather uncommon species may be readily distinguished when found, by the scattered tube-feet, the latter being distributed without order over the greater part of the surface of the body. It is from three to five inches in length and lives under rocks or buried to a slight depth in gravel about low-water mark. Ayres' (C), description of it in part is as follows: "The *suckers* are numerous, without order. The neck, for about half an inch behind the base of the tentacles, is nearly naked. A few suckers, however, are found on it, larger than those on the other parts of the body. The integuments here, also, unlike those of the other parts of the body, contain an abundant calcareous deposit. The *tentacula* are of very unequal development; two large, ramose, then two very small (scarcely exceeding one-tenth of an inch), two again large, etc., thus making ten pairs. In *color* this species is of a pale yellow, the neck and tentacles being purplish." Nothing is known of its habits or development.

25. **Pentacta frondosa,** (GUNNERUS), JAEGER. *Cucumaria frondosa* (GUNN.), FORBES, (U). *Cucumaria fucicola*, FORBES and GOODSIR, (A). [See Plate, Fig. 17.]

"Sea-Cucumber," "Sea-Pumpkin."

DESCRIPTION. (A) p. 209. (K) p. 99. (U) p. 2. (M) p. 347.

FIGURE. (A) p. 209. (K) p. 100. (U) pl. I.

DISTRIBUTION. *(a) General;*—Low water to one hundred and forty-one fathoms. South of Cape Cod to Greenland and Assistance Bay, (lat 74° N); around the North Atlantic to Scandinavian coast and British Islands, Spitzbergen. Alaska?

*(b) In N. B. waters;*—Grand Manan. "Nothing can exceed the profusion in which this species exists in some parts of the islands. It is found just below the ordinary low-water mark on rocky shores, and is, therefore, exposed at spring tides. I have seen areas of several square rods entirely occupied by them."—*Stimpson,* (D). Eastport, twenty fathoms, stony bottom, abundant, *Verrill,* (L); on the shores to fifteen fathoms, (N). Passamaquoddy Bay, L'Etang Harbor, very large, *Ganong,* (X). Gulf of St. Lawrence, *Whiteaves,* (P). Very abundant everywhere in the harbors of the southern coast.

This is one of the most abundant shore animals upon our southern coast. It is a good typical Holothurian, and affords a most excellent subject for dissection and study.

Its shape is quite well described by its name of sea-cucumber, or even better, of sea-pumpkin. When out of the water and in a contracted state, it is of an ellipsoidal, sometimes nearly spherical form; but when alive and undisturbed in the water it may take any one of several shapes, from long and slender cylindrical to short and rounded or even dumb-bell form. Large specimens, which are a foot long, have the power of extending themselves to two or three times that length. In cross section the animal is somewhat pentagonal in form, and at each of the angles is a band of tube-feet running nearly the entire length of the body, consisting of two rows, the individual members of one row alternating with those of the other. The skin is very tough and wrinkled and of a dark reddish or purplish brown or chocolate color on the upper side, shading to grey, flesh-color, or even white, on the side in contact with the bottom. The tentacles, which the animal may be seen to protrude when placed in a dish of water, or when undisturbed in some pool, are ten in number, much branched, and very graceful when fully expanded.

This species lives about and just below low-water mark, preferring hard bottoms and clear water. It can move but slowly and captures its food, consisting chiefly of small animals, by means of its tentacles. In its development it passes through a metamorphosis in which the fully-grown larva (*Auricularia*) is of a red color, cylindrical, with a few constrictions or annulations and four or five bands of cilia by means of which it can swim freely about.

It has already been pointed out in Section I. of this paper (p. 20) that this species is edible. Some further investigations into its value for food are much needed.

26. **Pentacta minuta,** (LÜTKEN), VERRILL. *Cucumaria minuta,* (FABR.), (M). *Ocnus Ayresii,* ST., (D). *Cucumaria frondosa* (GUNN.) FORBES, (U), [Young.]

DESCRIPTION. (D) p. 16.

FIGURE.

DISTRIBUTION. (*a*) *General;*—Sixty to one hundred and one fathoms. Maine, northward, and North European seas.

*(b) In N. B. waters;*—Grand Manan, "dredged on shelly bottoms, in twenty-five fathoms," *Stimpson,* (D).

There is some doubt as to whether this is a distinct species, or only the young of *P. frondosa.* Duncan and Sladen in their splendid memoir (U), hold to the latter view; Prof. Verrill, (L), (W), and others, believe the former. It is introduced here as a distinct species, on the authority of Prof. Verrill, who has had better opportunities to study it than others have had.

Following is Stimpson's description of the species, (D): "Completely encased in calcareous matter in the form of polygonal plates somewhat variable in size, but usually equalling in area one-half that of the disk of the sucker. These plates have regular and equal perforations in quincunx, smaller in width than their interspaces. The suckers are stout, and are distributed distantly in five rows, in the three ventral of which they are much larger than in the two dorsal. There are about seven suckers in each row, which are encased in the calcareous plates on their sides. The tentacula are short, and have few blunt branches. The color is white, or pale fawn. Length usually two-tenths of an inch; breadth 0.15 inch." Nothing is known of its habits or development.

## Order II. APODA.

*No ambulacral feet, usually no respiratory tree, and the tentacles usually branched or pinnate.*

### FAMILY SYNAPTIDÆ.

*Hermaphrodite and without respiratory trees. With symmetrical calcareous bodies in the skin.*

27. **Caudina arenata,** (GOULD), STIMPSON. [See Plate, Fig. 18.]

DESCRIPTION. (C) p. 143. (M) p. 358.

FIGURE. (K) p. 97. (M) pl. XX.

DISTRIBUTION. (*a*) *General;*—East Coast of America, Vineyard Sound to Massachusetts Bay and Gulf of St. Lawrence.

(*b*) *In N. B. waters;*—Point du Chêne, N. B., at low water, *Whiteaves*, (P).

[Selenka, (M), gives as a locality for this species, Grand Manan. But he was probably led into error by the fact that Stimpson mentions this species in his Synopsis in order to refer it to the new genus *Caudina.* Stimpson distinctly states that "it does not occur in the Bay of Fundy, notwithstanding its abundance on every sandy shore in Massachusetts Bay." Verrill says, (Q), he has never been able to find it at Grand Manan.]

This species is not likely to be mistaken for any other upon the Gulf coast, the peculiarity indicated by its generic name distinguishing it from all others. It is from two to four inches long, and over one-third of this length is so attenuated as to seem in comparison with the rest of the body like a "tail." When alive it is very worm-like in appearance, having no tube-feet, being semi-translucent and having a perfectly flexible skin. It shows, however, the stamp of the pentamerous Echinoderm plan in the five longitudinal lines which may be traced from end to end of the body, the representatives of the lines of ambulacral tube-feet. Around the mouth are about twelve short, non-retractile tentacles, each divided near the extremity into several slender branches. The skin has a finely granular appearance, caused, as the microscope will show, by the immense number of little calcareous, wheel like plates embedded in it. In color it varies from red to flesh-color.

*Caudina* lives buried a short distance in sand or mud in shallow water and is often thrown upon the sandy beaches of Massachusetts Bay in great numbers after a storm, and probably the same would be true upon our north shore. Little is known of its habits and nothing of its development.

28. **Chirodota lævis,** (FABRICIUS), GRUBE. *Trochinus pallidus*, (C), [See Plate, Fig. 19.]

DESCRIPTION. (C) p. 243. (U) p. 12.

FIGURE. (U) pl. I.

DISTRIBUTION, (*a*) *General;*—Circumpolar. Eastport to Grenland. Finmark and Lofoten, and possibly Ochotsk Sea and Sitcha.

(*b*) *In N. B. waters;*—Grand Manan, low water to four or five fathoms, *Stimpson,* (D). Eastport and Grand Manan, under stones at low water, common, *Verrill,* (L), (N). Devil's Head, St. Croix River, plenty, *Fuller,* (H). Craig's Ledges, Passamaquoddy Bay, lowest tides, abundant [under name *Synapta tenuis*], *Ganong,* (X). Gulf of St. Lawrence, *Whiteaves,* (P).

This Holothurian is very worm-like in appearance, with its long cylindrical body entirely free from suckers or other appendages. When alive it is transparent enough to show the internal organs and the five longitudinal rows of muscles. In the spaces between these rows are scattered little excrescences which are sometimes one twenty-fifth of an inch in diameter, and which under the microscope may be seen to be made up of a great number of little spicules in the form of beautiful and regular six-spoked wheels. There are twelve tentacles, each consisting of a base and ten to twelve branches or fingers. The animal rarely exceeds four inches in length. It is of a pale flesh-color when alive, and even in alcohol does not lose altogether its translucency.

As to its habits, Stimpson says: "This species is fully and well described by Otho Fabricius, and his account of its habits applies precisely to those of our species, as I have often observed at Grand Manan. It lives in the stony mud of the shores of these islands, buried to a depth of a few inches, usually in a horizontal position. It is found at low water, but is most abundant at a depth of four or five fathoms." Nothing is known of its development.

[Prof. Verrill tells the writer that in addition to those of the above list, he has from the Bay of Fundy two species of *Trochostoma* (formerly *Molpadia*), *Synapta,* one or two more species of *Thyonidium, Thyone scabra,* and probably others. These will be described in one of his coming reports].

## IV. SUPPLEMENTARY LISTS.

1. List of Species of Echinodermata dredged by Mr. Whiteaves, (P), in the deeper parts of the Gulf of St. Lawrence, but not yet reported from the Bay of Fundy.

### Ophiuroidea.

Astrophyton eucnemis, Mull. and Trosch.
Amphiura Holbollii, Lutken.
Ophioglypha nodosa, Lutken.
Ophioglypha Stuwitizii, [*fide* Verrill, (W).]
Ophioscolex glacialis, Mull. and Tr.
Ophiopeltis, *near* O. borealis, Sars.

### Asteroidea.

Asterias polaris, Mull. and Trosch.
? Pedicellaster palæocrystallus, Sladen. [*fide* Verrill, (W).]
Pedicellaster typicus, [*fide* Verrill, "Am. Jour. Sci." xvi., 214]

### Holothuroidea.

Pentacta calcigera, Stimps.
Eupyrgus scaber, Lutken.
Eupyrgus, nov. sp., *fide* Verrill.
Myriotrochus Rinkii, Steenstrup.
Oligotrochus vitreus, Sars. [*fide* Whiteaves MS.]
Molpadia turgida, Verrill. [*fide* Verrill, "Am. Jour. Sci." xvii., 473]

2. List of Species found by Mr. Whiteaves, (P), upon Orphan and Bradelle Banks, those shallow water outliers of the Syrtensian fauna of the deeper parts of the Gulf.

(*a*) On Orphan Bank.

Pteraster militaris.
Asterias grœnlandicus.
Psolus phantapus.

(*b*) On Bradelle Banks.

Astrophyton Agassizii.
Ophioglypha Sarsii.
Ophioglypha nodosa.
Psolus phantapus.
Ophiocoma nigra.

3. List of Species dredged by Mr. Whiteaves in the shallow southern basin of the Gulf, but not found within the limits of this paper.

Cucumaria pentactes, O. F. Muller.
Molpadia oolitica, Pourtales. } [*fide* Whiteaves MS.]
Eupyrgus scaber, Lutken. }

## V. THE COLLECTION AND PRESERVATION OF ECHINODERMATA.

Like other animals, and, indeed, like all natural objects, Echinoderms can only be studied from specimens. As far as possible, they should be observed in their own homes and under their natural conditions of life. But this is not enough; they must be taken away to where their anatomy can be studied at leisure and under more favorable conditions, and to serve to illustrate to others, and to arouse in them an interest in, these forms. How to collect, and, particularly, how to preserve Echinoderms, must therefore be an important part of our consideration of the group.

There are two methods of taking them, shore-collecting and dredging. The best localities for both are found where strong but not violent currents of the clearest water flow over bottoms of various kinds, but with rock and gravel predominating. For shore-collecting those places are particularly good where the tide leaves among the ledges pools with bottoms of gravel and scattered boulders. To such places the student should go at the time of the spring tides if possible, for the greater retreat of the water will lay bare many a treasure inaccessible at other times. He should go clad in his oldest clothes and long rubber boots, carrying with him one or two ordinary pails, some small bottles or vials of alcohol in his pockets, and a spade for digging in the gravel, the handle of which can be used as a lever for overturning stones. A companion to act as general assistant will be found of great value. Then, looking upon the less exposed open places, peering under ledges and among boulders, searching among the seaweeds, digging in the gravel, overturning stones and scanning their under sides, the student, if his heart be in his work, cannot fail of a rich harvest.

But many species live always below low-water mark, and to take such a dredge is required. The latter may be of the same pattern for all depths. It consists essentially of an iron frame, about eighteen inches long by six broad; the long sides are scraping jaws of thin flat iron, somewhat diverging; the short sides are simply round bars connecting the scraping pieces. From the sides slender bars run convergingly forwards for the attachment of the rope, and behind drags the bag (made of *very* coarse canvas, or, better, fine netting), which is to catch all that is loosened by the scraping jaws.* The dredge is to be dragged behind a sail boat, and the student will learn in a surprisingly short time all the proper methods, places, precautions, difficulties, pleasures and uses of dredging, which it would take many pages to set forth here.

There are two principal ways of preserving Echinoderms, dry or in a preserving fluid. The first method is much the less expensive and in many ways the more convenient, but is not suited for specimens which are to be used for the study of the internal organs or other soft parts. The only preservative fluid of value is alcohol, the ordinary spirits of wine of the druggists. Methyl alcohol or methylated spirits, which is cheaper, may be used for temporary storage and the like, but it is not so well suited for permanent preservation of valuable specimens. But no specimen should be plunged directly into the strong alcohol from water, for great shrinkage would result. They should be placed first in alcohol which has been diluted with nearly its own bulk of fresh water, left three or four hours and then be transferred to the stronger grade. Bottles with ground glass stoppers should be used for the permanent preservation of alcoholic material, as they reduce to a minimum the amount of evaporation.

For preserving specimens dry it is only necessary to fix in some way the tissues so that the animal will keep its shape, and then to dry it, preferably by artificial heat. A few Echinoderms do not need this preliminary fixing but may be dried at once.

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* The limits of our space will not allow of a full description of the dredge or dredging; such may be found in almost any work on seashore animals, such for instance as J. H. Emerton's "Life on the Seashore," [Salem, Bates.]

CRINOIDS. The Crinoids may be simply dried in the sun or by artificial heat, but being fragile are best preserved in alcohol. One can well afford the alcohol for a Crinoid.

OPHIURANS. So abundant are the hard parts in this group that if the internal anatomy be not needed, they may simply be dried, preferably by artificial heat. Better results are obtained by the method described below for Starfishes.

STARFISHES. Some Starfishes will keep their shape when simply dried in the sun, but most of them will expel water and collapse under this treatment. But if their tissues be hardened before the drying this will not happen. This can best be done by taking them very quickly from a glass vessel of water in which they are alive and expanded, and plunging them suddenly into a vessel containing enough alcohol of any grade beween forty and sixty per cent to cover them. In this they should be allowed to remain about half an hour, when they should be taken out and dried by artificial heat. This may be best done by placing them some distance above a stove upon a piece of cloth supported by a wooden frame. In this way the form and, to a great extent the color, of Starfishes may be beautifully preserved. Of course the alcohol can be used for this purpose over and over again. There can be substituted for the use of the alcohol in this method, fresh water heated nearly to boiling, in which the specimens are to be plunged for a few seconds only and then dried as above directed.

SEA-URCHINS. These may be treated as recommended for Starfishes, particularly when it is wished to retain the spines. If simply the shell is wanted, the animal should be boiled for a few minutes in a weak solution of caustic potash, when all animal matter can be easily washed away.

HOLOTHURIANS. These can be well preserved only in alcohol.

## EXPLANATION OF PLATE.

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FIG. 1. Antedon Eschrichtii. After ***Duncan and Sladen***, (U). One-half natural size.

FIG. 2. Gorgonocephalus Agassizii. After ***Duncan and Sladen***, (U). One-half natural size.

FIG. 3. Ophiopholis aculeata. After ***Agassiz***, (K). One-half natural size.

FIG. 3X. Ophioglypha robusta. After ***Duncan and Sladen***, (U). Three times natural size.

FIG. 3Y. Ophioglypha Sarsii. After ***Duncan and Sladen***, (U). One-half natural size.

FIG. 4. Asterias Forbesii. After ***A. Agassiz***, (K). One-half natural size.

FIG. 5. Brachiolaria of Asterias Forbesii. After ***E. B. Wilson***. From W. K. Brooks' "Handbook of Invertebrate Zoology." Greatly magnified.

FIG. 6. Stichaster albulus. After ***Stimpson***, (D). Natural size.

FIG. 7. Crossaster papposus. After ***Forbes***, (A). One-fourth natural size.

FIG. 8. Solaster endeca. After ***Forbes***, (A). One-fourth natural size.

FIG. 9. Cribrella sanguinolenta. After ***A. Agassiz***, (K). Natural size.

FIG. 10. Hippasteria phrygiana. After ***Verrill***. Report U. S. Fish Commission for 1883. One-fourth natural size

FIG. 11. Ctenodiscus crispatus. After ***A. Agassiz***, (K). One-half natural size.

FIG. 12. Pteraster militaris. Upper surface. After ***Duncan and Sladen***, (U). One-half natural size.

FIG. 12A. P. militaris. Under surface. After ***Sars***. Copied by ***Verrill***, Report U. S. Fish Commission for 1883. One-half natural size.

FIG. 13. Strongylocentrotus dröbachiensis. After ***A. Agassiz***, (K). One-half natural size.

FIG. 14. Echinarachnius parma. After ***A. Agassiz***, (K). One-half natural size.

FIG. 14A. Pluteus of E. parma. After ***J. W. Fewkes***, Bulletin Museum Comparative Zoology, Vol. XII., No. 4. Greatly magnified.

FIG. 15. Psolus phantapus. Under side. After ***Forbes***, (A). One-half natural size.

FIG. 16. Lophothuria Fabricii. After ***A. Agassiz***, (K). One-half natural size.

FIG. 16A. L. Fabricii, under side. After ***Duncan and Sladen***, (U). One-half natural size.

FIG. 16B. Larva of L. Fabricii. After ***J. H. Emerton***, "Life on the Seashore." Greatly magnified.

FIG. 17. Pentacta frondosa. After ***J. H. Emerton***, "Life on the Seashore." One-fourth natural size.

FIG. 18. Caudina arenata. After ***A. Agassiz***, (K). One-half natural size.

FIG. 19. Chirodota lævis. After ***Duncan and Sladen***, (U). Natural size.

## ARTICLE II.

# MOLLUSCS FOUND IN THE OYSTER BEDS OF COCAGNE, N. B.,

### BEDEQUE AND SUMMERSIDE, P. E. I.

BY REV. HENRY W. WINKLEY, OF ST. STEPHEN.

[Read 6th March, 1887].

The materials for the investigation which has yielded the accompanying list were as follows: Two barrels of oysters from Cocagne, N. B., one barrel from Bedeque, P. E. I., and about thirty-five barrels from Summerside, P. E. I. Small shells reported occur chiefly in the mud or sand dredged up with the oyster. The process of investigation has been to take either the oyster shells themselves, or the mud which settles in the barrel, or is left on the table where the oysters are opened, clean with a little water, then examine carefully, with a lens, all the fragments which remain.

The work has been done chiefly on oysters from Summerside, those being the ones at hand. Much more might be obtained by a careful search among other beds, but I give the list as it is.

Thanks are due to Mr. W. F. Ganong, of Harvard College, for his assistance in determining species.

An *extempore* talk, illustrated by the specimens found, was delivered before the society at its meeting in March. The following species were found:—

*Nassa trivittata.* Occurs occasionally at Summerside and Cocagne. Specimens small.

*Nassa obsoleta.* A single specimen from Summerside.

*Columbella lunata.* Occurs regularly at Summerside, varying in color from a very dark brown to a bright tint mottled with brown.

*Lunatia heros.* Dead specimens occur at North Summerside and Cocagne. Frequently they are grown to the oysters.

*Turbonilla interrupta.* More or less common at Cocagne and at Summerside.

*Odostomia trifida.* Abundant at Cocagne and Bedeque.

*Odostomia fusca.* Rare at Bedeque.

*Odostomia seminuda.* Abundant at Summerside.

*Cerithiopsis Greenii.* Not infrequent at Summerside. Occurs also at Bedeque.

*Bittium nigrum.* Common at Bedeque and occasionally found at Summerside.

*Littorina palliata.* Rare at Summerside, *i. e.*, in the oyster beds.

*Littorina tenebrosa.* One or two small specimens found at Summerside.

*Lacuna neritoidea.* One specimen (probably of this species) at Cocagne.

*Rissoa minuta.* Occasionally at Cocagne. Specimens not extra fine.

*Crepidula plana.* Very common and fine at Summerside. Occurs also at Cocagne and Bedeque. An interesting specimen in its variations, broad, long, flat, curved, and other shapes to suit its position. It lives attached to the shell of the oyster. Color varying from pure white to pea green. Largest about one inch long.

*Crepidula fornicata.* By far the most common, occurs in thousands, from one and a half inches in length to the minute young forms. It also clings to the oyster shell, or to those of its own species, sometimes there being three piled one on another, the lowest clinging to the oyster. Color externally is usually a dingy green or light cream mottled with brown. The interiors of no two are alike, striped, mottled, etc., with shades of maroon and cream color. One specimen had an interior almost jet black, and another is nearly pure white.

*Utriculus canaliculatus.* Occasionally at Summerside. One specimen from Cocagne shows that more might be found by searching.

*Anomia ephippium.* Occasionally at Summerside.

*Ostrea Virginiana.* Has been reported from all these places, but as it is the companion of all in this list, I include it.

*Mytilus edulis.* Abundant at Cocagne, occasional at Summerside, occurs also at Bedeque. This species presents interesting variations. On the south shore of the Province it is narrow with deeply arched valves, the interior nearly black in color. At Bedeque and Summerside the shape is broad and flat with a conspicuous white lining. There is a marked difference between the two places, however; a difference which looks like quality, Summerside shells being much finer in color and smoothness, those at Cocagne having a dingy look. The variety *pellucidus* occurs, and yields very fine specimens. A striped variety also occurs, having parallel bands of black and amber running lengthwise.

*Cardium pinnulatum.* Not infrequent at Summerside.

*Venus mercenaria.* In thirty barrels of oysters ordered from one firm at Summerside a single specimen occurred. In one barrel from another firm eight or nine were found. It evidently occurs in some parts to the exclusion of others. The type specimen seems to have tips of purple on the point (interior) in each shell. A pure white is found. Another has one valve colored and one white. Again it occurs with the purple color around the entire circumference.

*Tellina tenera.* This delicate and beautiful shell occurs at Summerside, but is so easily broken that only one whole specimen is reported.

*Petricola pholadiformis.* Rare at Summerside.

*Saxicava rugosa.* Occasionally, but very small at Cocagne.

*Pandora trilineata.* Not infrequent at Summerside.

*Cumingia tellinoides.* Occurs occasionally at Summerside, those found being mostly young forms.

*Corbula contracta.* Common at Cocagne.

*Mactra lateralis.* Summerside (?)

St. Stephen, N. B., March 26th, 1888.

## ARTICLE III.

## DOES OUR INDIGENOUS FLORA GIVE EVIDENCE OF A RECENT CHANGE OF CLIMATE?

BY J. VROOM, ST. STEPHEN, N. B.

The flora of New Brunswick is too little known, as yet, to warrant any attempt at giving a definite answer to the question. What follows is only suggested as a possible inference from some of the most striking features in the different floral regions of the province.

The plants of what we now call our indigenous flora have probably come to us from various directions and at different times. To trace the journeyings of any one species is, of course, impossible. We can only ask whether our sub-arctic plants have lingered here since the glaciers receded, or have once passed on in their northern migrations and been again driven southward to replace less hardy species; and whether a general movement in either direction is now going on.

A general movement of plants towards the equator is one of the acknowledged facts of geographical botany. The late Prof. Gray has also noticed that plants tend to move from east to west rather than from west to east. These movements would be almost infinitely slow—their rate not to be measured by years or by centuries, but rather by geological divisions of time—and the word recent must be understood accordingly. Reasoning from the laws above stated, an unchanging climate here, throughout such an extensive period, should have made continental Acadia, from its geographical position, a centre of distribution for the plants of the New England States. The same would be the case, and more noticeably so, if an increasing severity of the seasons had been forcing the southwestern migrations. But, if our climate is or has been growing milder, we should expect to find the New England flora advancing, and northern forms receding before it. Though the matter is by no means so simple as this, there are certain facts which seem to show that the latter is nearest to the true state of the case.

One ground for this opinion is found in the widely separated stations and scattered growth of plants of a northern range. Of a list of about one hundred and forty species that are more abundant elsewhere than within our province, nearly one hundred are of distinctly northern or northwestern distribution. Such a large majority seems to prove that the causes, whatever they are, which hinder such scattered plants from growing abundantly here are acting most strongly upon those of a northern range.

What at first appears as an objection to the argument is the fact that there are twelve southern species in this list of scarce plants. They are as follows:

Lechea minor,
Spergularia rubra,
Ilex verticillata,
Gaylussacia dumosa,
Fraxinus pubescens,
Limnanthemum lacunosum,
Polygonum hydropiperoides,
P. arifolium,
Xyris flexuosa, *var.* pusilla,
Cyperus esculentus (= phymatodes),
Scirpus atrovirens,
S. Clintonii.

Add to these Eleocharis Robbinsii, found in one locality in New Brunswick, and not yet reported in Maine, and we have a list of thirteen scattered southern forms. But it will be found that all but one of them are plants growing in water or in wet places, and just such as could be most easily carried by aquatic birds; and it may be argued that their seeds were brought here as plentifully at earlier times when birds of passage would have been as abundant as at present, and that a higher summer temperature is only now beginning to admit of their growth.

The continued existence of an isolated group of northwestern plants in the St. John valley is evidence that our climate has not since glacial times been very much warmer than at present;

while straggling members of the group seem to indicate that they have but recently retreated from the southern hills.

In contrast with these we have the following New England plants in the southwest of the province:

Viburnum acerifolium,
V. dentatum,
V. Lentago,
Cephalanthus occidentalis,
Lobelia cardinalis,
Potamogeton hybridus.
P. rufescens,
Cladium mariscoides,
Isoëtes echinospora, *var.* Braunii.

Some of these are scarce; others are very abundant in suitable localities. None of them have yet been seen farther east, but all occur in Maine. While for want of information they cannot be traced back in an unbroken line, yet they seem like the advanced guard of a host of invading plants, slowly advancing, and, unless checked by some secular change of climate, destined to cover the greater part of New Brunswick before they reach their limit of growth.

Though the evidence is not conclusive, and at best would not prove an interrupted amelioration of climate, still, it would seem, the present condition of our Acadian flora, to some extent, favors the opinion that our climate has, within comparatively recent times, been growing less severe, and the general tendency of plant migrations has been toward the north.

# APPENDIX.

## THE REPORT OF THE COUNCIL.

The Council beg to submit the following account of the condition of the society and the work done during the past year.

The membership has been increased by the addition of several ordinary, corresponding and associate members. Dr. Bailey, of Fredericton, has been made an honorary member, and Messrs. Chamberlain and Hay added to the life members.

The Sixth Annual Bulletin was published during the summer, and copies distributed to members, etc.

*Meetings.*—During the year eight regular meetings were held, at which papers were read as follows:

1887.
Feb. 1. Algæ of New Brunswick, by G. U. Hay, M. A.
Mar. 1. Florida and the Bahamas, by D. R. Jack.
Apr. 5. A Business Meeting.
May 3. Notes on Ornithology, by Messrs. Chamberlain, Cox and Morrisey.
Nov. 1. A Basal Series of Cambrian Rocks in Acadia, by G. F. Matthew. (Published in Canadian Record of Science).
Dec. 6. Origin of the Southern Fauna in the Gulf of St. Lawrence, by W. F. Ganong, B. A.
1888.
Jan. 3. On the Arctic Character of the Surface Fauna of the Bay of Fundy, by Prof. J. Walter Fewrkes.

*Library.*—A large number of books and pamphlets have been added to the Library, many in exchange for the Bulletin. Of these the more important are the Monographs and Bulletins of the United States Geological Survey.

*Museum.*—While there has been no large addition to any single department of the Museum this year, there have been considerable additions in several departments. The committees on Geology, Botany, Invertebrate Geology and Ornithology have done valuable work in their several departments.

*School of Science.*—A Summer School of Science was held during the first week of July under the auspices of the society, and was attended largely by teachers from the various parts of the Province. Practical instruction, both in the field and laboratory, accompanied the lectures and addresses on various branches of Natural Science given by several members of the society.

*Lectures on Science.*—Another important work undertaken by the society, and now in progress, is the course of lectures on Elementary Natural Science. They are conducted on the principle of the summer school referred to above. The series includes nineteen lectures on Chemistry, Mineralogy, Zoology and Botany, and thus far have been well attended.

In closing, the Council would express their thanks to the gentlemen who have prepared papers to be read before this society; and also to the city papers for publishing preliminary notices of the meetings.

# DONATIONS TO THE MUSEUM.

| Date. | Donor's Name and Article Presented. |
|---|---|
| 1887.<br>*Feb.* | M. Chamberlain.—Razor Bill Auk, Common Guillemot (from Murr Ledges), Sea Pigeon in Winter Plumage. |
| | Louis M. Todd.—Least Fly-catcher. |
| *Mar.* | W. D. Matthew.—15 species Molluscs, chiefly Pulmonifera of New Brunswick. |
| | John Moser.—200 species of Mosses of New Brunswick. |
| *May* | W. F. Best.—Horned Toad of California. |
| | Jas W. Banks.—Moth, Nests of Olive Backed Thrush and Hudson Bay Tit. |
| | Louis M. Todd, Calais, Me.—Fly-catcher. |
| *Nov.* | Jas. A. Estey.—Fossil Tree (*Lepidophloios*) from Nauwigewauk, King's Co. |
| | A. Markham.—Mollusc (*Conularia*) imbedded in Manganese, from Markhamville, King's Co. |
| | W. T. L. Reid, Fredericton.—Fossil Sponge (*Dictyophyton*), from Springhill, York Co. |
| | Mrs. C. E. Huestis.—Water Beetles (*Dysticus Harrisii*) Fresh Water Clams (*Unio complanatus* and *Margaritana arcuata*), Saucer Shell (*Pecten tenuicostatus*), Bonnet Limpet (*Crepidula*), all from Parrsboro, N. S. |
| | R. T. Saunders.—Butterflies, 30 species, from India and Japan. |
| 1888.<br>*Jan.* | Mrs. W. Bowden.—Fossil Plant, from Springhill Mines, N. S. |
| | G. F. Matthew.—Casts of two Trilobites (*Paradoxides, regina* and *P. lamellatus*). |
| | W. J. Wilson.—Two Ferns (*Onoclea sensibilis* and var. *obtusilobata*, Torr.), from Hanford Brook, St. John Co. |

# DONATIONS TO THE LIBRARY.

| Date. | Donor's Name and Title of the Book. |
|---|---|
| 1887.<br>*Feb.* | Smithsonian Institution.—Report, 1884, Parts I. and II. (November) Report, 1885, Part I. |
| | Alfred Seely.—Mosses of North America. |
| | Dr S. H. Scudder, Cambridge.—Earliest Winged Insects of America. |
| | Dr. A. R. C. Selwyn, Ottawa.—Economic Minerals of Canada. |
| | M. Chamberlain.—The A. O. H. Code and Check List of North American Birds. |
| | Director United States Geological Survey.—Bulletins Nos. 30 to 33; (March) Monograph No. 11, Geological History of Lake Lahontan; (April) Mineral Resources of United States, 1885; (November) Sixth Annual Report, Bulletins Nos. 34 to 39; (January, 1887) Mining Industries of Leadville. |
| | Rt. Rev. Bishop Kingdon.—Notice of the Chief Monuments in the Museum of Egyptian Antiquities at Cairo. Some Account of the Blackmore Museum, Salisbury. Catalogue of Salisbury Museum. Wiltshire Archæological and Natural History Magazine, Nos. 22, 24 to 68. |
| *Mar.* | Trustees of American Museum of Natural History.—Vol. I., No. 8; (November) Vol. II., No. 1. |
| *Apr.* | Academy of Natural Sciences, Philadelphia.—Proceedings, Part III.; (November) Part, I. |
| | New York Microscopical Society.—Journal, Vol. II., No. 9 and 9*a*; (November) Vol. III., Nos. 1 to 4. |
| | Natural History Museum, Vienna.—Vol. I., No. 4; Vol. II., No. 1. |
| | Société Malacologique de Belgique.—Proceedings, Vol. XV., 1886; (December) January to May, 1887. |
| *May* | Natural History Society of Montreal.—Canadian Record of Science. |

## Donations to the Library.—(*Continued*)

| Date. | Donor's Name and Title of the Book. |
|---|---|
| 1887.<br>*May* | Ottawa Field Naturalist' Club.—Proceedings, Vol. II., No. 3; (November) Proceedings for July and August, Vol. I., No. 8. |
| *Nov.* | F. W. Putnam, Cambridge, Mass.—Conventionalism in American Art. |
| | Peabody Museum of Archæology, Cambridge, Mass.—Report, Vol. III., No. 7. |
| | E. Gilpin, Esq., Halifax.—Quarterly Journal Geological Society, London. Jan., 1888, same Journal. |
| | Rt. Rev. Bishop Kingdon.—Wiltshire Archæological Magazine, No. 69. |
| | Geological Society, London.—Abstract of Proceedings, Nos. 476 to 492 and Nos. 493 to 509. |
| | Colorado Scientific Society.—Vol. II., Part II. |
| | Canadian Institute, Toronto.—Third Series, Vol. V., No. 1. |
| | Belfast Naturalists' Field Club.—Series II., Vol. II., Part VI. |
| | Natural History Society, Glasgow.—Proceeding, 1885-6, Vol. I. New Series, Vol. III. |
| *Dec.* | C. Richardson, Washington.—Analysis of Commercial Fertilizers. |
| | Geographical Society, Leipzig.—Proceedings, 1884 to 1885. |
| 1888.<br>*Jan.* | G. F. Matthew.—Art Memoirs of Museum of Lund, Sweden, 1867 and 1869. |

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*Invertebrates*—W. F. Ganong, P. R Inches, M. D., S. W. Kain.
*Reptiles and Fishes.*—Peter Campbell, S. W. Kain, W. S. Harding, M. D.
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*Hall*—G. E. Fairweather, W. J. Wilson, G. F. Matthew.
*Finance*—A. Seely, Edwin Fisher, W. J. Wilson.
*Press*—G. U. Hay, Thos. Stothart, S. W. Kain.
*Delegate to the Royal Society of Canada*—M. Chamberlain,
*Alternate*—W. F. Best,

# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

## No. VIII.

PUBLISHED BY THE SOCIETY

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1889.

# BULLETIN
OF THE
# NATURAL HISTORY SOCIETY
OF
# NEW BRUNSWICK.

## ARTICLE I.

## THE ECONOMIC MOLLUSCA OF ACADIA.

BY W. F. GANONG.

### SECTION I. INTRODUCTORY.

The following paper is not intended in any sense as an original scientific communication. It has been written for the use of students, teachers, and those interested in the knowledge and development of all of our resources; as a contribution to the much-needed literature which shall bring the results of the studies of scientific men, bearing upon practical questions, within the reach of the people; to present a synopsis of what is known in this year 1889 of the value, both actual and possible, to mankind, of all Molluscs living in the waters of these Maritime Provinces. It is hoped, that, within these limits, the work will be found to lack neither practical completeness nor scientific accuracy.

Such a work is nowhere accessible to Canadian students, and the rapidly developing interest in scientific education in these provinces, justifies the hope that this paper will in some measure fill a want, soon to be, if not already felt.

It is particularly appropriate that papers of this character should be presented to such a society as ours. The highest function of a local Society of Natural History must be admitted to be the patronage and encouragement of local Natural History in its practical and educational, as well as scientific aspects. In this it has a claim for support and for sympathy upon government and people, which greater pretensions would not warrant.

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The most valuable to man by far, of all the groups of Invertebrates, is that of the Mollusca. In all ages, in all parts of the world, savage and civilized men have utilized its members. The ancient refuse heaps of Europe show how old is the use of Molluscs as food; ethnologists have shown how wide-spread and old has been the use of shells for ornament, for money and for utensils of war and the home; and in more modern times, there have been found various other uses dependent upon the more numerous wants of advancing civilization. Unlike some other groups of animals, then, the Mollusca have been much observed by practical as well as scientific men; as in the useful plants, so among these, the useful forms are known to everybody.

Remembering these facts, we are not surprised to find, in works dealing with the exploration and early history of these provinces, that the edible Molluscs were the first Invertebrates to be noticed, excepting possibly some of the annoying Insects.

Jacques Cartier, the first explorer of the coast of Acadia who paid any attention to the animals and plants of the places he visited, does not mention any Invertebrates. It is not until we come to the works of Champlain and Lescarbot that we find references to the subject. Champlain's work, "Les Voyages du Sieur de Champlain," (Paris, 1613), records the earliest observations on the Mollusca of this region, but

Lescarbot's "Histoire de la Nouvelle France," was published first, appearing in 1609.* Champlain mentions the occurrence at the present Weymouth Harbor, St. Mary's Bay, Nova Scotia, of "many Shell-fish, such as Mussels, Cockles and Sea-snails," which he observed in his exploration in 1604. At St. Croix, now Dochet, Island in the St. Croix River, he found Cockles, Mussels, and Sea-snails, and in another passage he incidentally tells us what the Cockle is. Speaking of the Indians, he says, "when they do not hunt, they live on a shell-fish called the cockle," thus showing that he meant the Clam. The Clam, as a food-mollusc, is unknown in Europe, its place being in part taken by the *Cardium* or true Cockle, for which Champlain naturally mistook it. By Sea-snails he probably means the large Whelks, *Buccinum undatum* and *Lunatia heros*. His only other reference to Mollusca, is in his description of Bras D'or Lake, Cape Breton, in which he says,—"there are many islands filled with a great deal of game, and Shell-fish of several kinds, among others of Oysters which are not of good flavor." In the 1632 edition of his works, Champlain repeats these notes but does not add any new ones. They derive their interest from the fact that they are the very earliest references to our Mollusca known to us.

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*But Newfoundland can claim some earlier ones. In "A letter written to M. Richard Hakluyt of the middle Temple, conteining a report of the true state and commodities of Newfoundland, by M. Anthonie Parkhurst Gentleman, 1578," given by Hakluyt, Vol. III., pp. 170–174, it is said; "As touching the kindes of Fish . . . . there are . . . . Oisters, and Muskles, in which I haue found pearles aboue 40 in one Muskle, and generally all haue some, great or small. I heard of a Portugall that found one woorth 300 duckets: There are also other kinds of shel-fish, as limpets, cockles, wilkes, lobsters, and crabs: also a fish like a Smelt which commeth on shore [a marginal note says 'called by the Spaniards Anchouas, and by the Portugals Capelinas'], and another that hath the like propertie, called a Squid." And again,—"I tolde you once I doe remember how in my trauaile into Africa and America, I found trees that bare Oisters, which was strange to you, till I tolde you that their boughes hung in the water, on which both Oisters and Muskles did sticke fast, as their propertie is, to stakes and timber." No Oysters occur in Newfoundland, but as the writer refers more than once to Cape Breton, he probably includes what he saw there with what he saw in Newfoundland. Another writer in the same volume, p. 194, describing Sir Humphrey Gilbert's voyage to Newfoundland in 1583, says that Oysters do occur there;—"Oysters hauing pearle but not orient in colour: I tooke it by reason they were not gathered in season." He must confound some other mollusc with the Oyster. A little farther on, the same writer says:—"Lakes or pooles of fresh water, both on the tops of mountaines and in the vallies. In which are said to be muskles not vnlike to haue pearle."

Lescarbot speaks of the occurrence of Mussels at St. Croix Island, and referring to the natural productions of the country, says: "I would be forced to make an entire book if I should discourse on all the fishes which are common to the Brazilians, Floridians, Armouchiquois, Canadians and Souriquois. But I will restrain myself to two or three, after having said that at Port Royal there are great beds of Mussels, with which we filled our boats when sometimes we went to those places. There are also there, Scallops, (*Palourdes*),* twice as large as Oysters in size; also Cockles, which have never failed us." He makes a few other incidental references to this subject.

The next work to mention our Molluscs, appears to be the "Description Geographique et Historique des Costes de l'Amerique Septentrionale," and the "Historie Naturelle.... de l' Amerique Septentrionale," by Nicholas Denys, in 1672. The latter work, especially, contains several references of considerable interest, though of not much scientific importance. He knew of the occurrence of the Oyster at several points on the North Shore, notably around George's Bay, at Malagash (?), Tatamagouche, Pictou, at Cocagne and the Bras D'or Lake. Other Shell-fish he frequently refers to, and mentions their abundance at several places, for instance, the region near Cape Sable, La Heve Harbor, George's Bay, near the mouth of Bras D'or Lakes, Tatamagouche, Miramichi, Bathurst, Port Daniel. He noticed Razor-fish (*Coutellieres*), near Cape Sable, and Scallops (*Conniffle*), at La Heve. His interesting description of the Squid and of the oyster-fishery, will be noticed under the sections on those animals.

We have not been able to find that anything on this subject worthy of note was written during the last century. Occasional references to the North Shore oyster-beds occur, but nothing further. Charlevoix, in his "Historie de la Nouvelle France," (1744), is said to have referred to the manner of fishing Oysters on the coast of Acadia, which was the same as

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* Mr. J. H. Duvar tells the writer that the Acadian French of Prince Edward Island apply this word to the Quahog. It appears to have meant the Scallop to Lescarbot.

Denys describes, and the same as is used to-day. During the early part of this century, there were many works published, describing the three provinces and their resources, either for the encouragement of immigration or similar purposes. Many of these contain lists of the edible forms, with occasionally notes upon them. A fair sample of such lists is the following, taken from Robert Cooney's work, "History of Northern New Brunswick and Gaspé," published in Halifax, in 1832. Other Invertebrates are included, the Molluscs being italicized.

Blue crab.
*Smooth cockle.*
Lobster.
*Muscle.*
*Oyster.*
*Razor-fish.*
*Scollop.*
*Sea clam.*
*Shore clam.*
Star-fish.
Sea crab.
Soldier crab.
Sea urchin.
*Periwinkle.*

All of these will readily be recognized by the readers of the following pages.

In M. H. Perley's report on the Fisheries of New Brunswick (Fredericton, 1852), occur some really valuable though very brief notes, and in the Descriptive Catalogue of the Fishes of Nova Scotia, by Thomas F. Knight (Halifax, 1866), we find quite the best account of the economic Molluscs of these provinces which has appeared up to this time. On pages 43 to 54 of the latter is an account of the edible Molluscs of Nova Scotia, written by Mr. John Willis.* Many valuable notes are found also in the annual Fishery Reports of the Dominion. The splendid work recently issued by the United States government, "History of Useful Aquatic Animals" (Washington, 1884), gives a very good account of many of our Molluscs, but not with special reference to our waters. Other works, likely to be of interest in this connection, are mentioned in the list below.

A complete discussion of the economics of the Mollusca, in other words, of their relations to man's immediate interests, obviously includes a consideration of the injurious as well as of the beneficial forms. In the case of both of these, there is possible quite a natural division into those which are directly, and those which are indirectly, of injury or benefit, and this classification will be followed in this paper.

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*Mr. Knight says that this work by Mr. Willis, to which was appended a complete list of the Molluscs of Nova Scotia, had already been published in a colonial periodical. I have been unable to find, by careful inquiries, what that periodical was. I would be deeply grateful to any one who could give me this information.—W. F. G.

Of the direct uses to man of the Mollusca, the most important by far is that of food. The other uses must vary in importance with different ages, different localities, or different conditions of civilization. For our purposes we may consider the relative order to be as follows:

(1) Use as food for man.
(2) As bait in the fisheries.
(3) As fertilizers for land.
(4) For ornaments, including the production of pearl.
(5) For money.
(6) For the making of dyes.
(7) For dishes and many minor uses.

The most important of all food-molluscs is, of course, the Oyster. It is found in nearly all parts of the world except in the coldest seas, has been used from the remotest antiquity and is one of the most popular food-substances known. Many people have claimed that ours, of Acadia, are the best that are found in the world, and this much appears certain, that if not the best, they are among the best. Next in importance with us comes the soft-shell Clam, then the Scallop, the Quahog, Periwinkle, Razor-fish, Mussel, Whelk, Squid and one or two others. In Europe the Mussel takes the place of the Clam and the Periwinkle, and stands before it and just after the Oyster. It is most remarkable that Molluscs esteemed in Europe should be neglected in Canada, and *vice versa.* Though our common Clam is abundant in the former country, it is never used either for food or bait, while the Mussel and Whelk, highly esteemed and of great value there, are rarely utilized by our people. No doubt the greater variety of cheap food within reach of our poorer classes has something to do with this, for it is chiefly by the lower classes that those Molluscs are used in Europe.

The following table, compiled from the work of Dr. Atwater, will show the respective nutritive values of several of our Molluscs, that of beefsteak and salmon being added for the sake of comparison.

| | Per cent. of water. | Per cent. of nutrients. | Protein. | Fats. | Carbo-hydrates. | Mineral matters. |
|---|---|---|---|---|---|---|
| Beefsteak,...... | 60. | 40. | 19. | 20. | | 1. |
| Salmon,,........ | 63.2 | 36.8 | 22.6 | 12.9 | | 1.3 |
| Oyster (O. Virginiana.) | 87.3 | 12.7 | 6.0 | 1.2 | 3.5 | 2.0 |
| Clam (Mya arenaria.) | 85.9 | 14.1 | 8.5 | 1.0 | 2.0 | 2.6 |
| Quahog (Venus merceuaria.) | 86.2 | 13.8 | 6.6 | 0.4 | 4.2 | 2.6 |
| Mussel (Mytilus edulis.) | 84.2 | 15.8 | 8.7 | 1.1 | 4.1 | 1.9 |
| Scallop (Pecten irradians.) | 80.3 | 19.7 | 14.4 | 0.2 | 3.4 | 1.4 |

Other investigators have obtained results somewhat different from these, which give to the Oyster a higher nutritive value. Its value as food depends very largely upon conditions not shown by the table, such as easy digestibility and the like. For these reasons it is good for invalids and is frequently prescribed by physicians. It will be noticed that the Mussel has a higher nutritive value than the Clam, and that in some respects both are better than the Oyster.

Important as food-molluscs are to us, they were very much more so to the Indians who preceded us in Acadia. Everywhere on our coast, where Molluscs are abundant, we find heaps of shells which were thrown from the doors of the wigwams when their contents had been removed. These kept accumulating for ages and in places are acres in extent and two or three feet in thickness. They consist, upon the southern coast, chiefly of Clam shells, but also Mussels, Whelks, Periwinkles, Limpets and the Scallop have been found, some of these perhaps carried in accidentally. Mingled with them are the bones of the principal Mammals of the region, and household or hunting implements, doubtless lost by their owners. These camping-places were occupied chiefly in the spring and early summer when the land game was breeding and in poor condition, and life in the woods nearly intolerable on account of the insects. Indeed we have historical evidence that such was the case. Champlain tells us, "when they (the Indians) do not hunt, they live on a shell-fish called the cockle," the latter, as pointed out on a previous page, being the Clam. Denys, speaking of the region about George's Bay and Gut of Canso, tells us there was there "an abundance of Shell-fish of all kinds good to eat, which are the most important means of subsistence of the savages during the spring." There is, no doubt, much of interest to antiquarians, and something to naturalists, to be learned from a study of these shell-heaps. Those of the north shore have been investigated by Rev. Dr. Patterson, though not, as he tells the writer, with reference to their shells, while those of the southern coast have been explored by Mr. G. F. Matthew and others, references to which will be found below.[*]

For bait in the fisheries, the Squid and the Clam are of most importance to us. The latter has been used for a very long time, the former for not many years. It seems most remarkable that the Mussel, the same species as that of Europe, and as abundant, should be totally neglected for this purpose. In Europe it is considered the best of baits; it is easier to obtain than the Clam and it should be tried by our fishermen. The Whelks and other common Molluscs would undoubtedly be good for this purpose, but are not abundant enough to replace the omnipresent Mussel.

With us, the so-called mussel-mud is the most important fertilizer which the sea yields. This consists chiefly, however, of oyster-shells, and its value to Prince Edward Island is considered by Mr. J. H. Duvar to be as great as that of the living Oysters. We believe that the farmers of the Southern and Atlantic coasts would find a rich fertilizer in the masses of mud underlying the mussel-beds. In time the Mussels themselves are sure to become valuable, and certain beds should be left undisturbed. The Squid has been to some extent used for this purpose, but lately it has become too valuable as a bait to be so employed.

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[*] Discoveries at a Village of the Stone Age at Bocabec, N.B. By G. F. Matthew. Bull. N. B. Natural History Society, No. III., 1884, pp. 6–29.

Notes on Certain Aboriginal Shell Mounds on the Coast of New Brunswick and of New England. By S. F. Baird, Proc. U. S. National Museum. Vol. IV., 1881, pp. 292–297.

Also see Trans. N. S. Institute. Vol I., Part II., 1864. pp. 94–99.

The shells of but few of our Molluscs are available for purposes of ornamentation. Most shells of the Temperate Zone are plain and dull in comparison with the brilliantly colored and beautifully sculptured forms of the tropic seas. Hence a review of the subject as far as regards our waters would be very short in comparison with that of the world at large. Savage and civilized man have alike delighted to use them for personal and household decoration. Some of our Whelks or Spindle-shells are frequently seen as ornaments for mantels in fishermen's houses, and as borders for flower-beds in their gardens. Mussel-shells and the Cockle *(Cardium)* are made into ornamental dishes, pin-cushions and the like. The valves of Scallops, particularly of our great *Pecten tenuicostatus,* and the Beach Clam *(Mactra solidissima)* give a good surface for painting on, and are frequently thus utilized. No doubt our *Trochus occidentalis* and species of *Margarita* could be used for many minor purposes if they could be obtained in sufficient numbers; they are as beautiful as most of the shells made into shell boxes and the like. The Indians of America used wampum as an ornament as well as for money; the Indians of Acadia appeared to have employed it more for the former purpose than the latter. The subject will be further considered below.

By far the most important of ornaments yielded by Molluscs are pearls. The best, as everybody knows, come from the Persian Gulf and the coasts of Ceylon and Central America, and are found in the pearl oyster. Several of our Molluscs yield bodies, which, though pearly in their nature and mode of formation, yet lack the lustre of true pearls. Such occur in the Horse-mussel, Edible Mussel, and even in Quahogs, Clams and Oysters, of which the first two have the nearest true pearls in appearance. Those of the Edible Mussel have had some commercial value in England. In the Mussels of our fresh water streams, however, we have pearls produced, of which the value will, no doubt, astonish many of the readers of this paper. The species producing them have, unfortunately, not been fully worked out, but they belong for the most part to the genus *Margaritana.* Pearls from fresh-water Mussels are found in Europe, and were known from very early times. Those from our River-mussels have sometimes great beauty; as much as is known of their value will be found in a subsequent part of this paper.

In many of the East India Islands, the only money which can be used in traffic, consists of the shells of the Cowry (*Cypræa monetum*). Traders are obliged to provide themselves with a store of it beforehand, and formerly many tons were annually collected and sent to England for the use of traders. This is the most conspicuous example of the use of shells as money, which occurs to us, but many other savage tribes utilized shells for this purpose. Indians of the west coast of America used species of *Haliotis* or Ear-shells, and other tribes, strings of *Dentalium* or Tooth-shells. Among the east coast Indians and those of the interior, wampum was the great medium of exchange and was a true currency. White wampum was made from the central column of the shell of two species of Conch (*Sycotypus canaliculatus,* and *Fulgur carica*); purple and the more valuable wampum, was made from the purple part of the shell of the Quahog or Round Clam. These were made into beads, not more than half an inch long, which were strung on threads, the threads being sometimes fastened together side by side to form belts. This was very extensively used by the east coast Indians in their traffic with one another and with the whites. In Acadia it appears to have been used more for ornamental and ceremonial purposes than for money. The Passamaquoddies had "Wampum Records" as Mr. Leland tells us in his "Algonquin Legends." Lescarbot, in his "History of New France, (1609, book VI., chap. XII.), has left us a most interesting account of its value to the Micmacs, which, as it has apparently escaped the notice of the writers on this subject, is here given in full.

"The Brazilians, Floridians and Armouchiquois, [*i. e.*, the

Indians from Kennebec to Cape Cod,] make carcanets and bracelets (called *bou-re* in Brazil, and *matachiaz* by our Indians), from the shells of those great sea-shells which are called VIGNOLS and are like unto snails, [*i. e.*, the large Conchs, *Sycotypus* and *Fulgur*] which they break and gather up in a thousand pieces, then polish them upon a (hot)* stone, so that they make them very small, and when they have pierced them, they make beads, like to those which we call procelain. Among these beads they mingle alternately other beads, as black as the others I have spoken of are white, made of jet or of certain hard or black woods which resemble it, [meaning probably dark purple wampum,] which they polish and make as small as they wish, and this has a good grace.

"And if things are to be esteemed for their fashion, as we see exemplified in our merchandise, these collars, scarfs and bracelets of VIGNOLS or porcelain, are more valuable than pearls (netwithstanding no one will believe me in this), for they esteem them more than pearl, gold or silver. As with us, so in this land do the women deck themselves with such things, and will make a dozen turns of it around the neck, hanging upon the breast, and around the wrists and below the elbow. They also hang long chains in their ears, which hang down even as low as their shoulders. If the men wear any it is only some young one who is in love. But at Port Royal and thereabouts, and towards Newfoundland, and at Tadoussac, where there are neither pearls nor VIGNOLS, the maids and women make *matachiaz* from the quills or bristles of the porcupine, which they dye with black, white and red colors, as vivid as possible : for our scarlet has no better luster than their red dye. But they prize much more the *matachiaz* which comes to them from the land of the Armouchiquois and buy it at a very high price. And since they can get but a little of it, because of the war which these two nations [*i. e.*, the Micmacs and the Armouchiquois,] have always between each other, there is brought to them from France *matachiaz* made of little tubes of glass mixed with tin or lead, which are

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*The word used is *grez*, which is translated by Erondelles, " hot stone."

traded to them by the fathom-measure for want of an ell-measure." As Lescarbot points out, the shells from which the white wampum was commonly made, do not occur upon the shores of Acadia, and the Acadian Indians do not appear to have manufactured the purple wampum, though the material for it was abundant on the North Shore. Denys mentions that they wore among their ornaments, "white and violet porcelain," and goes on to say,—" they make of it also pendants for the ears, which they have pierced in two or three places. This porcelain is nothing else than the teeth (dents) of a certain fish which is taken by the savages in New England, and which is very rare there and at this time is very much valued among them; that which is common now, has each grain of the length of half a finger's breadth."

Prof. Bailey mentions the occurrence of wampum in an Indian grave on the Tobique, though made, as he thinks, from the shells of Fresh-water Mussels.

The most noted dyeing material of ancient or modern times, that which gave the Tyrian Purple, was obtained from Molluscs which are closely allied to our Purple-shell (*Purpura lapillus*). The latter shell, exceedingly abundant on our shores, itself yields an unchangeable rich crimson dye, which can easily be obtained. The expense of collecting it, however, is much too great to allow it to be of any commercial value. The Long Whelk (*Buccinum undatum*) also is said to yield a dye.

Of minor uses for shells, there are very many. Several of the large bivalves, notably the Scallops and the great Sea-clam (*Mactra*) are used by fishermen's wives and others for dishes. The Acadian Indians made their pottery in part from powdered shells, and no doubt made much use of them as household utensils. Oyster shells are frequently used for road-making in the United States, and of course could be so utilized with us. They are said to be among the best of materials for this purpose. In the United States, shells of various kinds, chiefly Oyster and Scallop, are strewn upon the oyster-beds to give a clean firm surface for the young to attach themselves to. Oyster-shells are also ground up to be given to poultry. From the Squids a kind of oil can be made, though we believe it has little value commercially.

Of the indirectly useful Molluscs, doubtless the most important to man, are those which serve as food for the food-fishes. A list of the Molluscs known to inhabit New England waters, which are eaten by Cod, Haddock and other large fish, is given in the "History of Useful Aquatic Animals of the United States," pp. 693, 694 and 703. The majority of the forms there mentioned occur in the waters of Acadia. It may not be amiss to state here, that the stomachs of fishes are fine hunting-ground for the conchologist, many species being found in them, which are rare, or inaccessible in other ways.

Indirectly also those Molluscs are beneficial to man, which, by forming great tough beds, as the Edible Mussels do, protect easily eroded sea-coasts from being washed away; which bore into and ultimately remove reefs and wrecks which are a bar to safe navigation, as does the *Teredo* and its allies; and those which are beneficial to the oyster industries, the most important of which is the Periwinkle (*Littorina litorea*), and some others.

Among the injurious Mollusca, the Ship-worms must take first place. Species of *Teredo* are found all over the world, but are most destructive in warm waters. They bore into and destroy any kind of timber that is under the surface in pure salt water. Hence, wharves, ships, buoys, breakwaters, are all attacked, and naturalists and engineers have been put to their wits' ends to study their habits and find a remedy. In the following pages will be found some account of their results. In Acadian waters we have some three or four species; they are most troublesome upon the North Shore and Cape Breton coast, where the warmer summer temperature affords better conditions for the development of the young, than does the much colder water of the Atlantic and Bay of Fundy shores. Those Molluscs which bore into stone (*Pholas* and allies) have never done any damage upon our shores.

Among those which may be called indirectly injurious, are those which are destructive to oyster-beds. In American waters there are a number of these, the chief of which is the

Drill (*Buccinum cinereum*), which is present upon our own North Shore. This Mollusc does great damage in the United States, but little on our oyster-beds. Indeed, as elsewhere pointed out, the chief oyster enemies of the United States are either absent altogether from our waters, or do but little damage—a circumstance of great advantage to future culturists. Other indirectly injurious Molluscs are the Squids, which destroy large number of herring and other small fish. It will of course be evident that an animal may be, at different times and in different ways, both beneficial and injurious.

Is it not remarkable that the first attempt at mollusc-culture in Acadian waters was contemporaneous with its first settlemont in 1604? It was so, though in a rudimentary form. Lescarbot, in describing DeMont's settlement at St. Croix Island (Dochet Island of to-day), says: "There is also a little chapel built after the fashion of the savages, at the foot of which there is such a store of mussels as is wonderful, which may be gathered at low tide, but they are small. I believe that Monsieur DeMont's people did not forget to choose and take the biggest and left there but the small ones to grow and increase." Thus was one of the axioms of modern mollusc-culture observed by the first settlers on the shores of Acadia. Nothing more, even of this simple kind, seems to have been done until the experiments of Hon. Mr. MacFarlane, in Nova Scotia, and Hon. Mr. Pope, in Prince Edward Island, to be spoken of in connection with the Oyster.

The need of mollusc-culture for the present time in Acadia, resolves itself into the need of oyster-culture. No other Mollusc on our shores is fished to anywhere near its limit of natural productiveness, much less beyond it. But as our food-molluscs came to be extensively used, as they ultimately must, regulations of the fishery should be enforced from the first, and not after the supply verges on exhaustion. In the case of the Oyster, there is need of immediate and vigorous government interference, not only for the protection of the present beds, but for the encouragement of the planting of new ones. To culturists there must be given not only an absolute right to the products of their labor and protection from trespassers, but even, if necessary, positive encouragement in the way of bounties, until Oyster-culture shall become an established industry of the Dominion. Canada does not now produce more than a fraction of the Oysters she uses; it is soon to become a question of deriving the greater part of her supply frem cultivated beds in the United States or from cultivated beds in Canada, for the natural beds of the United States are rapidly becoming exhausted, and attention is being directed towards culture.

Something should be said here as to the distribution of Molluscs in our waters. It will be noticed by those who read the following pages, that many forms are spoken of which occur in the Gulf of St. Lawrence and not elsewhere north of Cape Cod; others occur in the Bay of Fundy, the distribution of which is circumpolar or arctic. These are two among very many facts which indicate a curious distribution of animal life in Acadian waters. In the southern part of the Gulf, all along the North Shore of New Brunswick and Nova Scotia and all around the coast of Prince Edward Island and Cape Breton, occur animals of species identical with those living to the south of Cape Cod, and in most cases they do not occur in numbers between those localities. The Oyster, Quahog, Drill (*Urosalpinx*), Plicated Mussel, are all examples of this, and many others might be mentioned which do not fall within the limits of this paper. In the Bay of Fundy and on the coast of Nova Scotia, south of Chebucto Bay, on the other hand, the forms are decidely northern, the uniformly cold water of that region not allowing of the development of the young of such southern forms as can thrive in the Gulf. In the latter, the shallow waters, little disturbed by tides, can become very warm during the summer, and favorable conditions thus being provided for the young, the adults survive them in spite of the cold of winter. For the origin of this condition of affairs we must look to geological causes, the discussion of which is not in place here. The substance of it is, that in times recent geologically (certainly post-glacial), an elevation of the land in this region threw the Labrador current off from the coast and allowed the water inside the Banks, then near the surface, to become warmed up in summer, as it is to-day in the Gulf of St. Lawrence. These forms then crept northward and all the coast from Virginia to Newfoundland was occupied by them. The land is now sinking; cold currents are coming back to our shores and the southern animals cannot hold their own against the northern, which are better fitted for the new conditions. It is probable that ultimately all of these southern forms will become extinct in the Gulf, but the time is so remote that the practical man need not take it into his calculations.

It should be hardly necessary to call attention to the fact here, that there is yet very much to be learned about the distribution of Molluscs and other animals upon our shores; about their habits, their relations to other animals, their usefulness and noxiousness to man. Even in the matter of their value and palatableness as food there is much need of information. There is an abundance of work for every observer to do, and teachers who interest themselves and their pupils in such subjects will be repaid many fold, not only by the facts observed and training acquired, but by their further initiation into the spirit of nature and their refreshment by the pure air of new fields, both figurative and literal.

In the following list, the nomenclature adopted is not in all cases that of the latest authorities, though such names are always given in the synonymy. The scientific name given first is usually that of Binney's Edition of Gould's Invertebrata of Massachusetts, though in certain instances where the latter is clearly erroneous, as in the Cephalopods, those of other writers are followed. The work mentioned is the only one extant which gives an account of our Mollusca, and, unfortunately, is rare and expensive, though it is to be found in most scientific libraries. Those who wish scientific descriptions and figures should turn to it, and there they will find references to other works of importance. The list of works given below includes only those consulted in the preparation of this paper.

An interesting part of the present subject is that of local names for our Mollusca. As soon as a species comes to be much used, it requires a special distinctive name, and such the fishermen generally give it. As so few of our own Molluscs are utilized for any purpose, very few of them have common names, and in such cases we have felt at liberty to adopt for those lacking them, the best of those by which they are known to English fishermen. The writer would be very thankful for any information which could be given him as to local names applied to Mollusca in any part of these provinces.

We believe no explanation is needed of the use of the word Acadia throughout this paper. The three maritime provinces are, zoologically, botanically and geologically one, and a term by which they can be collectively designated is a necessity in scientific if not other writing. Several writers on the natural history of the region have employed the word Acadia, and what more appropriate name can ever be used?

## WORKS OF REFERENCE.

Descriptive Catalogue of the Fishes of Nova Scotia. By THOMAS F. KNIGHT. *Halifax*, 1866, 8vo, 54 pp. Pp. 43 to 54 treat of "Edible Mollusca of Nova Scotia."

[This part dealing with Mollusca is in reality by Willis, for Mr. Knight says: "The author is indebted to J. R. Willis, Esq., of Halifax, for the following ample description of our Edible Mollusca, which has already been published in a colonial periodical." Can any of our readers tell us what this periodical was, and its date? We have not been able to find any trace of it.]

Mollusca of Nova Scotia. By J. MATTHEW JONES. *Proc. and Trans. of Nova Scotian Institute of Nat. Science.* Vol. IV., Part III., 1877, pp. 321-330.

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British Conchology. By J. GWYN JEFFREYS. 5 vols. *London*, 1862-69.

Edible Molluscs of Great Britain and Ireland, with Receipts for Cooking them. By LOVELL REEVE. *London*, 8vo. pp. 210, date (?) [Not seen by the writer].

Commercial Products of the Sea. By P. L. SIMMONDS. *New York*, 1879, 8vo, viii.+484 pp., woodcuts.

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Contributions to the Knowledge of the Chemical Composition and Nutritive Values of American Food-fishes and Invertebrates. By W. O. ATWATER. *Rep. U. S. Fish Commission for 1883*, pp. 433-499.

A Review of the Fishing Industries of the United States. By G. BROWN GOODE. *London*, 1883, 8vo, 84 pp. (Fishery Exhibition Literature, Vol VI.)

Catalogue of the Economic Mollusca, etc., exhibited by the United States National Museum at the International Fisheries Exhibition. By Lieut. FRANCIS WINSLOW. *Bull. U. S. National Museum, No. 27.* 1884, pp. 185-270. Also a list by G. BROWN GOODE, in Bull. No. 14, 1879, pp. 251-259.

Fisheries and Fishery Industries of the United States. By G. BROWN GOODE and others. Section I. History of Useful Aquatic Animals. Section V., Vol. II. The Oyster, Scallop, Clam, Mussel and Abalone Industries. Washington, 4°, 1884, and later.

Fisheries Exhibition Literature, London, 1883-84. 16 vols.

I wish here also, to return a grateful acknowledgment to those gentlemen whose kindness to me in replying to my enquiries has added much to the completeness of this paper. To Mr. John Tilton, Deputy Minister of Fisheries, for copies of Fishery Reports; to Mr. J. H. Duvar, Inspector of Fisheries in Prince Edward Island, and my friend Mr. S. W. Kain, of St. John, for much information I am particularly indebted. Mr. H. Piers, of Halifax, Mr. J. A. Turner, of St. John, and Mr. John Sharp of Summerside, have also patiently answered my troublesome enquiries, for which I am sincerely thankful to them. The Micmac names of Molluscs have been taken verbatim from Dr. Silas T. Rand's "First Reading Book in the Micmac Language." The Milicete, or, more properly, Passamaquoddy, names have for the most part been given me by Mr. H. Lyle, of St. Stephen. Figures 3, 5 to 17, 19 and 21 are from Binney's Gould. Figure 4 is reduced from the same. Figures 18, 20, 22 are from Verrill's Report on Invertebrates of Vineyard Sound. Figures 1 and 2 are reduced from the latter's Monograph on Cephalopods of North-eastern Coast of America. All have been reproduced by the Heliotype Company of Boston.

## SECTION II. A LIST OF THOSE MOLLUSCS OF THE WATERS OF ACADIA WHICH ARE USEFUL OR INJURIOUS TO MAN.

### ANALYSIS.

### A. USEFUL MOLLUSCA.

#### (*a*) Directly useful.

1. As food. See *Ostrea Virginiana*
   - *Mya arenaria.*
   - *Mya truncata.*
   - *Pecten tenuicostatus.*
   - *Pecten Islandicus.*
   - *Pecten irradians.*
   - *Venus mercenaria.*
   - *Mytilus edulis.*
   - *Modiola modiolus.*
   - *Solen ensis.*
   - *Mactra solidissima.*
   - *Mactra ovalis.*
   - *Cyprina Islandica.*
   - *Zirphœa crispata.*
   - *Cardium Islandicum.*
   - *Littorina litorea.*
   - *Lunatia heros.*
   - *Buccinum undatum.*
   - *Fusus Islandicus.*
   - *Fusus decemcostatus.*
2. As bait in the fisheries. See *Ommastrephes illecebrosa.*
   - *Loligo Pealei.*
   - *Mya arenaria.*
   - *Mya truncata.*
   - *Mytilus edulis.*
   - *Mactra solidissima.*
   - *Mactra ovalis.*
   - *Buccinum undatum.*
   - *Purpura lapillus.*

3. As fertilizers. See *Ostrea Virginiana.*
*Mytilus edulis.*
*Modiola plicatula.*
*Ommastrephes illecebrosa.*
*Loligo Pealei.*

4. For ornaments, including pearl.
See *Margaritana.*
*Venus mercenaria.*
*Mytilus edulis.*
*Modiola modiolus.*
*Cardium Islandicum.*
*Pecten tenuicostatus.*
*Mactra solidissima.*
*Buccinum undatum.*
*Fusus Islandicus.*
*Fusus decemcostatus.*

5. For money. See *Venus mercenaria.*

6. For dyes. See *Purpura lapillus,*
*Buccinum undatum.*

7. For dishes and minor uses.
See *Ostrea Virginiana.*
*Pecten tenuicostatus.*
*Mactra solidissima.*
*Mytilus edulis.*

### (*b*) Indirectly useful.

(1) As food for fishes. See Introduction of this paper, p. 15.

(2) Protection of coasts from erosion, etc.
See *Mytilus edulis.*
*Modiola modiolus.*

(3) Removal of wrecks and obstructions to navigation.
See *Teredo navalis.*

(4) Of value to oyster beds. See *Littorina litorea.*

## B. INJURIOUS MOLLUSCA.

### (*a*) Directly injurious.

1. Destructive to sub-marine timber.
See *Teredo navalis.*
*Teredo norvagica.*
*Teredo dilatata.*
*Xylophaga dorsalis.*

2. Molluscs occasionally poisonous.

See *Mytilus edulis.*
*Modiola modiolus.*
*Pecten tenuicostatus.*

(*b*) Indirectly injurious.

1. Destructive to oyster beds.

See *Buccinum cinereum.*
*Purpura lapillus.*
*Lunatia heros.*
*Mytilus edulis.*

2. Destructive to young fish.

See *Ommastrephes illecebrosa.*
*Loligo Pealei.*

## Class CEPHALOPODA.

1. **Ommastrephes illecebrosa** (Lesueur) Verrill.

*Ommastrephes sagittatus* Ferussac.

[Verrill thinks that this species is not identical with the European *O. Sagittatus.* The *Loligo Bartramii* of Stimpson, in his Synopsis of the Marine Invertebrata of Grand Manan is this species.]

**Squid, Short-finned Squid, Sea-arrow, Flying Calamary.**

*Micmac,* Sedaasoo-k. *Passamaquoddy,* Sah tah sis.
*Acadian French,* Alcorne.

[*Ommastrephes*, turning its eyes; *illecebrosa*, very attractive.]

DISTRIBUTION. (*a*) *General;*—Rhode Island to Cumberland Gulf.

(*b*) *In Acadia;*—Abundant around the entire coast of the three Provinces. Verrill says it is "abundant from Cape Cod to Newfoundland."

**Habits.** The Squid is easily recognized and is one of the best known of our Molluscs. It is the most highly organized of the group, and in its appearance and most of its habits, resembles a fish rather than what it really is.

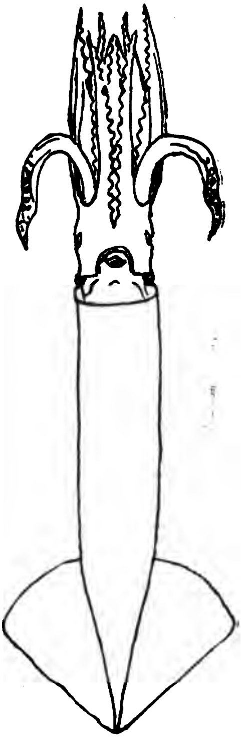

Fig. I.—*Ommastrephes illecebrosa.* Young male, three-sevenths of natural size.

The body is cylindrical, tapering to a point at the posterior end, and in front bears a head which has ten arms arranged in a ring around the mouth. These arms bear sucking disks on their inner sides, in the two longer near their extremities only. and in the other eight quite to their bases. The mouth is armed with a stout horny beak similar to that of a parrot. The large and very bright eyes are on diametrically opposite sides of the head; they have lids and a round pupil. The neck is well marked, sharply separating the head from the body. On the under side of the latter, projecting forward, is a stout process with an opening at its apex which might be mistaken for a mouth. It is the opening of the tube or siphon by which water is drawn into and expelled from a sac inside the body, this being, as will be explained below, its locomotive apparatus. At the posterior end, attached on the dorsal side, is the broad caudal fin which extends a little more than a third (about two-fifths) of the length of the body proper. It extends out laterally on each side of the latter and is shaped like the quadrant of a circle, the arc being to the front and the two radii sloping to the extreme posterior end. An average specimen is fourteen inches in extreme length, the body proper being eight inches; length of fin about three inches; body one and one-half inches in diameter.

In the interior on the back of the animal, and running the entire length of the body, is a translucent, horny pen-shaped structure, called the "pen." This is in reality the shell, reduced and carried inward instead of covering the outside of the animal.

The color is variable in the extreme. The ground color is pale bluish-white, and in the skin are many chromatophores, or cells containing colored pigments, any set of which can be expanded or contracted at the will of the animal. It is thus that the rapid changes of color are caused—red, orange and brown seeming to predominate in this species. Prof. Verrill says:—"The colors change constantly, when living or recently dead, by means of the continual contraction and dilation of the chromatophores. The different tints pass over the surface like blushes."

The Squid, so well named Sea-arrow, is extremely swift and graceful in its movements. It swims by the forcible ejection of water from its siphon, the reaction driving the animal backward with great velocity. The arms pressed close together, trail out behind, and the fin, used to balance or steady the body when the animal is moving slowly, is wound tightly around it when it goes swiftly. But the siphon can be pointed backward and the animal go forward, when necessary, though it does so much less easily than it can go backward. It lives upon young herring or mackerel, following the schools in to the coast. It takes these fish by darting in among them, turning suddenly to one side, and seizing one which it kills by a bite in the back of the neck. Squid move in schools, and are most active at night. They often come ashore in large numbers, on account, no doubt of their running backwards. When much alarmed they discharge with the water from the siphon an inky fluid which blackens the water around. It is eaten by many fishes.

Nothing is as yet known of its breeding habits. Professor Verrill, arguing from the structure of the reproductive parts, believes it will be found that the eggs are cast free into the ocean, and float singly or in masses on the surface.

ECONOMICS. Fifteen or twenty years ago the Squid would hardly have found a place in a paper of this character. Its great, almost its only, use is as a bait for cod and other large fish, and it is only of late years that it has come to be so extensively used. In Newfoundland, especially, it is taken in enormous quantities, both for the use of the native fishermen and for sale to those of the United States. It is the chief reliance of the latter for their fishing on the Grand Banks; for though they bring salted clams or other bait, Squid are always preferred. They are mostly caught by native fishermen, who sell them for from twenty-five to forty-five cents per hundred. The French have vessels specially devoted to taking and delivering it. There are no statistics to show the extent to which it is used; but one writer states that the number annually used by United States vessels alone would "be reckoned high in the tens of millions." Mr. Ingersoll estimates that five hundred vessels and boats are annually engaged in taking Squid for bait. In the United States it is at present rarely or not at all taken for this purpose.

In Canada it is fast assuming great importance, as the following table will show. They are officially considered to be worth $4.00 per barrel, though in certain instances much higher prices are quoted. To find the number of barrels divide the value by four.

VALUE OF SQUID TAKEN IN THE MARITIME PROVINCES FROM 1881 TO 1887.

| | 1881. | 1882. | 1883. | 1884. | 1885. | 1886. | 1887. |
|---|---|---|---|---|---|---|---|
| New Brunsw'k | ...... | $ 500 | $ 208 | $ 1,972 | $ 1,392 | $ 2,256 | $ 2,816 |
| Nova Scotia... | $9,600 | 13,200 | 17,464 | 10,782 | 12,556 | 17,576 | 121,280 |
| Total, .... | $9,600 | $13,700 | $17,672 | $12,704 | $13,948 | $19,832 | $124,096 |

Prince Edward Island sends no returns. In New Brunswick they are caught chiefly in Charlotte and Gloucester counties, and in Nova Scotia in Guysborough, Halifax, Victoria and Inverness counties. Large quantities are also taken on the Coast of Quebec from the St. Lawrence River to Blanc Sablon in Labrador.

The Squid is universally taken by means of a "jig." This is a cylindrical piece of lead two inches long, having an eye at its upper end, and at its lower a circle of radially arranged, unbaited hooks with the points upwards. These are moved up and down in the midst of the schools of Squid, and when one is hooked (no bait is used) it is quickly drawn up. In using it for bait it is usually cut into three pieces, thus baiting three hooks. When possible it is used fresh, but upon long voyages it has to be salted. It is the best bait for cod known to the fishermen.

In addition to its use as bait it has been employed in Newfoundland as a fertilizer. Ordinarily, it is far too valuable to be used for this purpose, but when great masses of them are thrown upon the beaches, as they sometimes are, it would be well for the farmers in the vicinity to remember that they have this value. Its use as food is not unknown. Rev. Philip Tocque, in his work on Newfoundland, speaking apparently of this species, says: "The Red Indians of Newfoundland esteemed it a great delicacy, it being eaten raw by them. It is rarely eaten by the inhabitants of Newfoundland, being generally considered unfit for food. It is, however, a well-flavored fish, and is excellent either boiled or fried; it tastes much like the large claws of the lobster."

As is well known, it is from the ink of an allied form that the India ink of commerce is obtained. We cannot find that any experiments have been tried to determine the value of this species for that purpose. Probably it would not pay to capture it especially for this, but if worth while the ink bags of those used in the fisheries could be saved, the fishermen putting all good ones aside as the Squid are cut up for bait.

It is interesting in this connection to note that it was long ago upon our own shores considered good food. Denys in his "Histoire Naturelle" of 1672, speaking of the Squid in Acadia, says: "The Squid [Leucornet] is another fish formed about like the cuttle-fish. It has arms around the head of the length of half a foot or thereabouts, with which it takes fish for food. To capture it a fire is made on the shore at the edge of the water. At night on the flood tide it comes towards the land and, leaving the sea, lands high and dry upon the beach which is often found quite covered with it. It is about a foot in length, quite round, larger in the middle than at the ends; the end of the tail is pointed at which there is a border of two fingers in size all around, like a little round shield. It is good to eat roasted, boiled and fried; it makes the black sauce just as do the Calamaries in France, which are little cuttle fishes. These fishes are found there in the sea as large as hogsheads. These latter never come to land, where only the little ones are seen in the spring and autumn."

n the latter sentence we have apparently a reference to the giant cuttle-fish of Newfoundland, lately described by Prof. Verrill. The entire description shows an accuracy of observation which is quite surprising, considering the time and the little attention then paid to such matters.

### WORKS OF REFERENCE.

The Cephalopods of the North-eastern Coast of America. By A. E. VERRILL. Part II., The Smaller Cephalopods. *Trans. Connecticut Academy of Arts and Sciences*, Vol. V., 1880, pp. 259–446. Also in *Rep. U. S. Fish Commission for 1879* (published 1882), pp. 211–450. Also short paper in *American Naturalist*, Vol. VIII., 1874, pp. 167–174.

The Squid of the Newfoundland Banks in its relation to the American Grand Bank Cod Fisheries. By H. L. OSBORN. *American Naturalist*, Vol. XV., 1881, pp. 366–372.

Natural History of Useful Aquatic Animals. Pp. 687, *et seq.*

## 2. **Loligo Pealei** Lesueur.

### Long-finned Squid.

[*Loligo*, the ancient name; *Pealei*, for R. Peale of Philadelphia.]

DISTRIBUTION. (*a*) *General*;—South Carolina to Massachusetts Bay. Cape Ann, St. Croix River.

(*b*) *In Acadia*;—St. Croix River.

[In June, 1886, the writer found two specimens of this species in a weir at the Devil's Head in the St. Croix River. The only other evidence of its presence in our waters that we have been able to gather, has been obtained from Mr. Henry Frye, of Frye's Island, Charlotte County, a close and accurate observer of all such matters. He says that we have in our waters two kinds of Squid, the "short-tailed and the long-tailed." The former must be *O. illecebrosa*, and the latter can be only the species we are considering. It had not previously been known to naturalists to occur north of Cape Ann, and its distribution and relative abundance in our waters are entirely unknown.

It is altogether likely that the specimens from the St. Croix River belong to the variety BOREALIS of Verrill, which the latter established for his specimens from Cape Ann, and which he calls "nothing more than a local or geographical variety."]

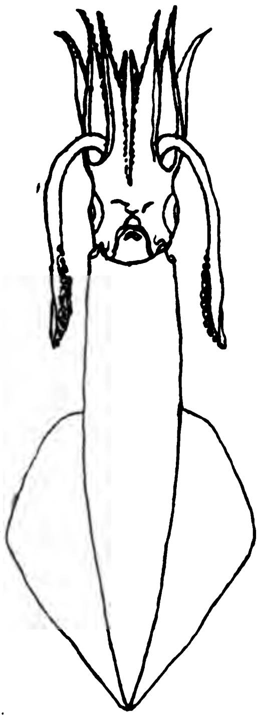

FIG. 2.—*Loligo Pealei.* Female, one-third of natural size.

HABITS. In appearance the long-finned Squid differs little from the short-finned, the most marked difference being indicated by their names. In *L. Pealei,* the caudal fin extends over one half the length of the body, clearly distinguishing it from *O. illecebrosa,* in which it is not more than two-fifths of that length. The "pen" in the former is much broader than in the latter, The eggs are laid in gelatinous capsules, attached to some support.

ECONOMICS. It is of precisely the same use to man as the last species, though from its more southern range, it is little used for bait. It is the common Squid south of Cape Cod. It has been tried as food by the New York Ichthyophagous Club, and pronounced "rather tasteless."

WORKS OF REFERENCE.

As for *O. illecebrosa.*

## Class GASTEROPODA.

:3. **Fusus decemcostatus** Say.

*Tritonium decemcostatum Midd.*
*Neptunea despecta* Lin., *var.* carinata.
*Neptunea decemcostata* Say.

**Ten-ribbed Spindle-shell.**

[*Fusus,* a spindle; *decemcostatus,* ten-ribbed.]

DISTRIBUTION. (*a*) *General;*—Low-water mark to forty fathoms. Cape Cod to Sable Island.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, low-water mark to forty fathoms, *Stimpson.* L'Etang Harbor and Passamaquoddy Bay, *Ganong.* Particularly large, fine and abundant about low-water mark at Hospital Island, Passamaquoddy Bay; (in N. S.) Annapolis Basin, abundant, *Verkrüzen.* Halifax Harbor, *Jones.* LaHave Bank, *Jones* (on authority of *Verrill.*) Sable Island, *Gould* (on authority of *Willis*). Not yet reported from Prince Edward Island or the Gulf of St. Lawrence. Probably rather common in sand and mud on the Bay of Fundy coast, and perhaps less so on the Atlantic shores. May be very rare or quite wanting in the Gulf of St. Lawrence.

HABITS. This is a very striking shell, and one easily distinguished from all others by its ten raised revolving ribs. The ground color is a dully fulvous or yellowish-red, but the ribs are darker. Of these there can always be counted nine, generally ten and rarely more on the lower whorl, of which only two, rarely three, revolve on the upper whorls. The ribs being large and very solid, give the shell a handsome fluted appearance. The lower end tapers to a canal. It is about three inches in length, though frequently somewhat larger. It seems to prefer mud and sand bottoms in rather shallow water on our coasts, rather than rocks in deep water as Gould suggests. In L'Etang Harbor it is often dredged with mud, but occurs in greatest perfection and beauty in the clean sand and clear water about low-water mark, at Hospital or Little Hardwood Island in Passamaquoddy Bay. There it lives half-burrowing in the sand, with only its spire projecting at times, and leaving deep furrows behind as it works its way along. Specimens from this locality are very clean and bright and show no trace of the parasitic growths which

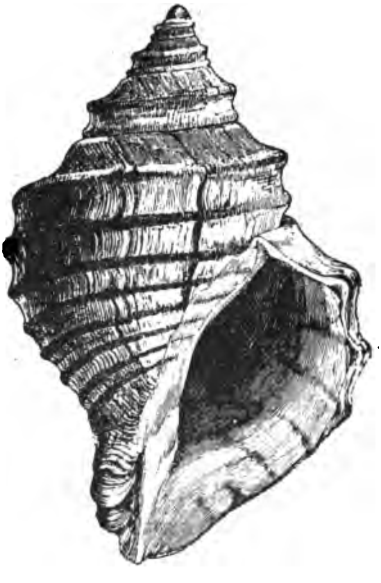

FIG. 3 —*Fusus decemcostatus.* Natural size.

seem to be always present on specimens from mud bottoms. We do not know what it feeds upon, but it is probably carnivorous like *Bccinuum undatum.*

ECONOMICS. It is an excellent article of food. Willis tells us that it is "much scarcer and more esteemed as an article of food than *Fusus Islandicus.*" We do not find that it is ever eaten by the fishermen or offered for sale in our markets. On the Bay of Fundy coast at least, it is more abundant than *F. Islandicus,* and as it lives near low-water mark, and is not solitary, but gregarious, it may be gathered in larger quantities than the last mentioned species. Nevertheless it is too scarce to be of much commercial value.

4. **Fusus Islandicus** Gould.

*Fusus curtus* Jeffreys.
*Tritonium Islandicum* Lovén.
*Neptunea curta* Verrill.
*Sipho Islandicus* Chemn.

**Spindle-shell.**

[*Fusus,* a spindle; *Islandicus,* Icelandic.]

DISTRIBUTION. (*a*) *General;*—Low-water mark to eighty fathoms. Massachusetts Bay to Labrador, and (if identical with European form) North European Seas to Great Britain.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, low-water mark to forty fathoms, *Stimpson.* Bay of Fundy, low-water mark to eighty fathoms, *Verrill.* Passamaquoddy Bay, *Ganong.* Gulf of St. Lawrence, over one hundred fathoms, *Verrill.* (in N. S.) Annapolis Basin, abundant, *Verkrüzen.* Halifax Harbor, *Jones.* Pretty common in deep water around the coast, *Willis.* Not yet reported from Prince Edward Island. Probably nowhere very abundant, though to be found on all the Bay of Fundy and Atlantic coast.

HABITS. This is the species described by Dr. Gould, under the above name, but it is now generally considered that it is a distinct species and should be called *F. curtus.* It is so closely allied to the European *F. Islandicus,* however, that it is undoubtedly useful for the same purposes.

The common name of this species is very appropriate, for it tapers to both ends. The shell is very graceful, being symmetrically spired above and prolonged into a slender curved canal below. It is of a dull bluish-white color when deprived of its thin horn-colored epidermis, and is white within. The whorls show a few revolving lines. The animal is white, with small irregular specks of black. It is usually about three inches in length when full-grown.

But little is known of its habits. It probably lives upon animal food. It occupies rocky bottoms, generally in water from thirty to fifty fathoms in depth, though in the Bay of Fundy the strong tides afford it at low-water mark the cold water it needs. It never lives in schools, but singly, on which account it is difficult to obtain it in any quantity, and being comparatively scarce it can never be of much value.

ECONOMICS. It may be used as food. Willis says of it: "Parties who have eaten it inform me that they consider it quite a delicacy." We do not find that it is ever eaten by the fishermen, and it is never for sale in any of our markets. It would doubtless form good bait for cod, pollock, etc. The shells are used as mantel ornaments in fishermen's houses.

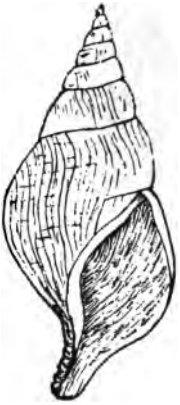
FIG. 4.—*Fusus Islandicus.* One-half of natural size.

### 5. **Buccinum cinereum** Say.

*Urosalpinx cinerea* St.

**Drill, Borer, Snail-bore.**

[*Buccinum*, a trumpet; *cinerea*, ashy.]

DISTRIBUTION. (*a*) *General;*—About low-water mark and in shallow water. Coast of Florida to Massachussets Bay. Casco Bay, Gulf of St. Lawrence.

(*b*) *In Acadia;*—Southern part of the Gulf of St. Lawrence, *Verrill.* Prince Edward Island, *Dawson.* Distribution probably coincides with that of the Oyster, though it seems to be nowhere abundant.

HABITS. It is a very rough, dull-colored shell, looking not very unlike *Buccinum undatum*, but is smaller, rougher and generally lighter in color. It is longer in proportion to its breadth, has the revolving lines more marked and tapers to both ends. The adult is about an inch in length. It has, like other Gasteropod Molluscs, a "tongue" or lingual ribbon, set with sharp siliceous teeth. This ribbon can be moved back and forth so that its acts like a file. It is so arranged that it moves in the arc of a vertical circle, and by its use the animal can bore a clean round hole through an Oyster-shell: then by means of its proboscis it can suck out the juices of its victim. It deposits its eggs in short-stalked capsules on the under surfaces of stones. It lives chiefly upon Oysters, but to some extent upon other Mollusca. It is said not to attack the Mussels.

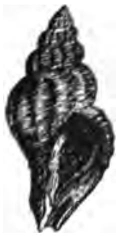

FIG. 5.—*Buccinum cinereum.* Natural size.

ECONOMICS. This Mollusc is of importance to man on account of its destructiveness to Oysters. Other Gasteropod Mollusca, such as *Purpura, Natica, Nassa*, etc., also prey upon Oysters, but their combined ravages are unimportant compared with those of this species. It is very destructive to the beds on the coast of Long Island and New Jersey, and in the Chesapeake. Once having attacked a bed, it is almost impossible to get rid of it. Dredging with fine-meshed dredges and the careful destruction of their eggs wherever found in shallow water, seem to be the methods adopted and recommended for keeping them down. They do not spread rapidly, and its careful removal from seed Oysters in planting new beds would do much to prevent its spread. They seem at times to make sudden and combined attacks on the beds in certain localities. Damage to the extent of tens of thousands of dollars annually is done to the beds in the localities mentioned above.

Such is the case in the United States. But upon our own North Shore we may congratulate ourselves on its comparative scarcity. It seems to do but little damage there. This is doubtless due to the fact that it is a rock-loving species, and the sandy character of the shore is unfavorable to it. In the United States it is chiefly troublesome in rocky situations. We have here another exemplification of the excellence of our North Shore for purposes of Oyster culture, and another protest against our improvidence and lack of wisdom in allowing our splendid opportunities not only to lie unimproved, but to be positively misused.

WORKS OF REFERENCE.

E. Ingersoll. "History and Present Condition of the Fishery Industries," U. S. 10th Census, pp. 232-233; *also,* "Natural History of Useful Aquatic Animals," p. 697.

### 6. **Buccinum undatum** Linnæus.

### Whelk, Long Whelk.

[*Buccinum*, a trumpet; *undatum*, waved.]

DISTRIBUTION. (*a*) *General;*—Above low-water mark to six hundred and fifty fathoms (Verrill); New Jersey to Arctic Ocean and around North Atlantic to Great Britain and France.

(*b*) *In Acadia;*—(in N. B.) abundant everywhere on Charlotte County Coast; Northumberland Strait, *Whiteaves.* (In N. S.) Annapolis Basin, moderately abundant, *Verkrüzen;* whole coast, *Jones.* Prince Edward Island, *Dawson.* Probably abundant around the entire coast of the three provinces.

HABITS. It has been considered by some writers that our common shore Whelk is not the same species as the *Buccinum undatum* of Europe. But those who have given the question the most recent and most careful study consider them identical; and in any event, it does not matter for our present purpose which is the case. They are so nearly alike in all respects that they are one so far as their uses to man are concerned.

As would be expected from the great variety of conditions as to temperature, depth, freshness of water, etc., under which it is found, this species is quite variable in form, size and color. Yet it presents characteristics which enable it to be always readily distinguished when once a student becomes acquainted with it.

The only littoral shell with which it can be confounded is *Purpura lapillus.* But, unless quite young, it is much larger than the latter, an average size being three inches in length.

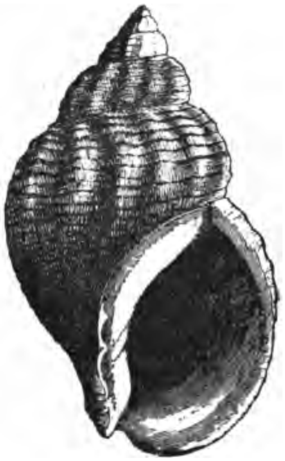

FIG. 6.—*Buccinum undatum.* Natural size.

The "waves" or rounded longitudinal ridges on the whorls also, twelve or thirteen on each, are but rarely or never seen in *P. lapillus*. Another good distinguishing character, which seems to remain constant for all sizes and ages, consists in the shape of the lowest part of the free edge of the opening, the apex being considered the upper end of the shell. In *P. lapillus* this is more or less angular, and never lower than the lowest point of the columella or central pillar around which the whorls are wound. In *B. undatum*, on the other hand, it is always evenly rounded, and always a little lower than the extremity of the columella. The epidermis is generally yellowish, though variable, and the interior of the shell is frequently of a beautiful golden-yellow. It has been known to grow to a length of more than six inches.

The Whelk is not at all particular as to the kind of shore or bottom it inhabits, or as to its depth. Near low-water mark on our coast, it may be found in mud, sand, gravel, or rocks, feeding chiefly on animal food. At Oak Bay, Charlotte County, they occur in perfection, and their habits may there readily be studied. They are frequently seen at that place feeding upon dead fish, and it is chiefly through their fondness for such food that they are captured in England and Ireland. There round wicker baskets, a foot in diameter, with a hole in the top, baited with cod or other fish, arranged to allow them to get in but not out, are lowered in from five to fifty fathoms of water, and drawn up and emptied at intervals, much as our lobster-traps are. Other methods are, to lower a baited hoop-net, two feet in diameter, or a long line on which small crabs are strung. The Whelks cling to either of these and are readily captured. They must be kept alive for bait. It appears that its love for cod is fully reciprocated, for they are eaten in great numbers by that and other fish, for which it is consequently a very valuable and attractive bait. We do not know that it has been observed perforating other shells as *Natica* and *Purpura* do. It can live in quite brackish water.

Its eggs are laid in lens-shaped capsules, one-fourth of an inch in diameter, each containing many eggs. Great numbers of capsules are deposited together, forming large irregular rounded masses, which are attached to stones or seaweed below low-water mark. The young have the shell well developed before they leave the capsules.

ECONOMICS. This is a Food-mollusc of very great importance in Great Britain. In Vol. VI. of the Fisheries Exhibition Literature we are told, "The edible Whelk is considered a very nutritious and strengthening food, and is always free from poisonous matter. I have heard fishermen say that a dish of Whelks does them as much good as a beefsteak." It may be bought in all the coast towns of England and Scotland, and is esteemed as a luxury by the poorer classes of London. To show the importance of this Mollusc in Great Britain, it may be said that a sandy flat in Whitstable Bay was estimated in 1866 to yield £12,000 worth of Whelks annually, a part of the product being sold in London markets for food and the remainder sent to the cod-fishing banks for bait. The Great Grimsby fishery is valued annually at £22,-500. For food, they are best in August and September, but are in season all the year round. It is said they should be used the day after being captured, but if boiled they will keep several days. Many vessels are engaged in their capture.

In the United States it does not appear to be eaten, and is used to only a limited extent, if at all, for bait. Dr. Robert Bell tells us, however, that it has been used for bait along the lower St. Lawrence.

In Acadia it does not appear to be known at all as food. Mr. Willis says that though abundant in Nova Scotia, it was rarely used as food.* He tells us further that,—"It is said to be quite as nutritious and delicate, by those who have used it, as the species which is found on the British coast." It is never exposed for sale in our markets, and is unknown even by name to dealers in St. John. We do not find that it is used by our fishermen to any extent as bait.

In Europe, the fishermen call the eggs "sea-wash balls," and as they form a lather with salt water, use them, when found, instead of soap for washing their hands. The shells are sometimes used as a decoration for the borders of flower beds and for other similar purposes in places near the sea. It is asserted in the "Natural History of Useful Aquatic Animals," (p. 699), that this species has been the subject of successful experiments for the obtaining of dyes, though we are not given any particulars.

Is it not a remarkable fact that a fishery of so great value in Europe should be entirely neglected here? There can be no doubt, however, that in the course of time the Whelks will come to be extensively used in Acadia. This will come

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*Recipes for cooking *B. undatum* may be found in Tryon's Manual of Conchology, Vol. III., pp. 179, 180.

**to pass as the country becomes more populous, and as our poor classes become poorer, as the history of civilization tells us they must. It is chiefly by the poorer classes that the Whelk is used in England. When the fishery does begin to become of importance, regulations for its protection should be enforced from the first. In England, the only restriction that is found to be needed, is as to the taking of the young; those under one and three-fourths inches long must be returned to the water.**

### 7. **Purpura lapillus** (Lin.) Lamarck.

#### Purple-shell, Dog-periwinkle, Dog-whelk.

[*Purpura*, Tyrian-purple shell; *lapillus*, a little stone.]

DISTRIBUTION. *(a) General;*—Between tide marks and in very shallow water. Long Island (rare South of Cape Cod) to the Arctic Ocean; around the North Atlantic to Northern Europe and south to the coast of Africa. North-eastern coast of Asia to Japan; Sitka, Alaska, and possibly south to California.

*(b) In Acadia;*—(in N. B.) Very abundant on the Bay of Fundy coast from Grand Manan to St. John and probably much further. Not reported from the North Shore, but surely occurs there. (In N. S.) Annapolis Basin, abundant, *Verkrüzen;* all rocky shores, *Jones;* Prince Edward Island, *Dawson.* Probably occurs everywhere on our coasts in rocky places and tolerably clear water.

HABITS. So variable is the shell of this animal, and so few constant characters does it present that it is difficult to describe it. It is, without doubt, the most variable shore shell we have. Sometimes, when living in very sheltered places, it is nearly as thin as this paper; again, when exposed on rocky reefs, it may be of a thickness a dozen times as great. Sometimes it is white, sometimes orange, or gray, or brown, or any neutral shade. While usually of a nearly uniform color, it sometimes shows broad revolving bands, one to three in number, of pure white on a dark ground. Sometimes quite smooth, again it is finely sculptured with longitudinal lines of raised scales, and there is every gradation between these extremes. It varies, too, in form, and in length proportional to the breadth. The only shore form which it resembles is the young of the Whelk, *Buccinum undatum.* From this it differs in the absence of the longitudinal undulations and in the shape of the lowest part of the free edge of the opening. As stated under the description of *B. undatum,* this in *P. lapillus* is more or less angular and never lower than the lowest point (the apex being considered the upper end of the shell) of the columella, or central pillar around which the whorls are wound. In *B. undutum* on the other hand, it is always evenly rounded, and always a little lower than the extremity of the columella. Through all its variations, it yet presents a certain individuality of its own not describable in words, which makes it easily recognizable when once the student has become familiar with it.

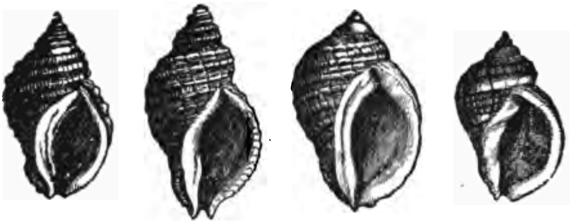

FIG. 7.—*Purpura lapillus.* Natural Size.

The Purple-shell lives upon rocky shores between high and low-water marks, particularly near the latter. It rather prefers exposed situations and is often found on ledges exposed to the full force of the ocean swell. It is very voracious and attacks nearly all of the littoral Molluscs, into the shells of which it can easily bore an opening by means of its file-like tongue. One writer tells us that it can bore through the shell of the common Mussel in from three to five minutes, while others, with more show of probability say that it takes two days. Can not some of our teachers or students who live near the shore, throw some light upon such questions at this? Through the hole, not larger than a large pin head, the animal thrusts its proboscis, and sucks out the juices of its prey at its leisure. The Oyster is a favorite food, and great damage is done to Oyster beds by this species. In England it is considered "one of the greatest if not *the* most destructive of the Oyster's enemies." It has been so bad at times on the English beds that sixpence per hundred has been paid to collectors. It also attacks species of Littorina, Limpets, small Naticas and its own kind. It feeds very largely upon the common shore Barnacles, *Balanus balanoides,* thrusting its proboscis between the opercular valves of that species. Its egg-cases, urn or vase shaped, smooth, about one-fourth of an inch long, of a yellow or cream color tinged with pink, are found attached in groups on the under sides of stones, and in crevices of the ledges, at low tide. The young remain in them until their shell is well-formed and they are able to shift for themselves.

ECONOMICS. This is one of a number of Molluscs which furnish rich purple or crimson dyes. Indeed, it was a species of this same genus which afforded a part at least of the famous Tyrian purple dye. Small shells of the genera *Murex* and *Purpura*, containing the animals, together with the color gland alone from larger individuals, were pounded up together in mortars and mixed with five or six times their weight of water. To this was added twenty pounds of soda to each hundred pounds of the mixture and the whole was placed in leaden or tin dishes. It was then exposed to the sun for a few days, until the desired hue was obtained, when the wool was placed in it and left for a few hours. The wool came out dyed unchangeably of the color reserved for the garments of kings and emperors. Indeed, it was far beyond the reach of any but the most wealthy—so very expensive was it. Simmonds tells us in his "Commercial Products of the Sea," that in the reign of Augustus, one pound of wool dyed with Tyrian purple sold for about £36 sterling. This was because of the tediousness of the process, and the small quantity of color obtained from each Mollusc. It is now never used on a commercial scale, partly on account of its expense and partly because cheaper substitutes have been obtained from the cochineal insect and later from the coal-tar or aniline colors.

In the work last mentioned we find the following, referring to the Mollusc under consideration. "If the shell of *Purpura lapillus* is broken, there is seen on the back of the animal, under the skin, a slender, longitudinal, whitish vein, containing a yellowish liquor. When this juice is applied to linen, by means of a small brush, and exposed to the sun, it becomes green, blue and purple, and at last settles into a fine unchangeable crimson. Neither acids nor alkalies affect its color, and it may be conveniently employed in marking linen where an indelible ink is desired." And as Mr. Ingersoll adds, "The housewives of New England, therefore, have growing abundantly on their sea-side rocks little living bottles of indelible ink which cannot be excelled by any manufactured product for either beauty or durability, since neither acid nor alkali will affect its color." In these facts are shown an interesting though not commercially valuable use for this species. It would be far too expensive a process to attempt to dye with it, but for the purpose suggested (*i. e.*, its use as indelible ink), it may have a limited local value. Jeffreys says the egg-capsules will also give the color, and with less trouble than the parent animals. Dr. Bell states that this species was used somewhat as bait for Cod along the lower St. Lawrence, but we do not know that it has ever been so used in Acadia.

A more important economic interest in this animal for us arises from its relation to Oyster-beds and Oyster-culture. While it gives much trouble and causes much loss to United States oystermen, it seems to be quite rare and harmless on the Oyster-beds of the Gulf of St. Lawrence, doubtless owing to the fact that it lives on rocks, of which there are comparatively few in that region. Indeed Mr. Whiteaves did not find it at all at Shediac. This fact is another to show how favored by nature are Acadian Oyster-waters, and is an additional indication of the possibility of profitable Oyster-culture upon our shores.

### 8. **Lunatia heros** (Say) Adams.

*Natica heros* (Say).

**Round Whelk.**

[*Lunatia*, half-moon shaped; *heros*, a hero.]

DISTRIBUTION. (*a*) *General;*—Low-water mark to forty fathoms. Georgia to southern coast of Labrador.

(*b*) *In Acadia;*—(in N. B.) Abundant everywhere on sand and mud bottoms on the southern coast, from Grand Manan to Quaco. Near Dalhousie, *Bell.* Shediac, *Whiteaves.* (In N. S.) Annapolis Basin and St. Mary's Bay, *Verkrüzen.* All sand beaches, *Jones.* Sable Island, very large, *Willis.* Prince Edward Island, *Dawson.* Probably to be found on sandy and other soft beaches around the entire coast.

HABITS. Though this species possesses little economic value, it is a most conspicuous shore shell. It is as large as *Buccinum undatum*, or larger, and nearly as abundant. With that species it cannot be confounded, for it has a very low spire, no waves, lines, or sculpturing of any kind except the simple longitudinal lines of growth, and an aperture simply rounded below with no sign of a notch or canal. It is generally ash colored, and about two and a half inches long and two inches broad. It grows much larger than this, however, in favorable situations, and Willis mentions that he has had specimens from Sable Island measuring four or five inches in length, and broad in proportion.

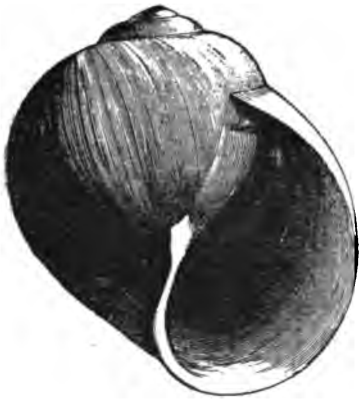

FIG. 8.—*Lunatia heros.* Natural Size.

The Round Whelk is rarely found in rocky situations, preferring sand and mud bottoms. It is not as particular about the purity of the water it inhabits as is generally supposed, for it is found up the St. Croix River at the Raven's Head and perhaps further. On the flats of Oak Bay, especially on the borders of the deeper parts, it is exceedingly abundant, and there its habits may be easily watched. It not only lives on the surface, but beneath it, the great expanded muscular foot enabling it to burrow readily.

Everywhere on the flats around our coast, there may be found valves of Mussels, Clams and other shells, many of which show a neatly bored round hole, one sixth of an inch in diameter. These are the remains of the victims of *Lunatia.* Grasping the shell with its powerful foot, it rasps a hole through it with its file-like tongue, inserts its proboscis, and sucks out the juices and soft parts. Not only bivalves, but various Gasteropods* are attacked by it, and it is said even its own young. It even attacks successfully the great Beach-clam (*Mactra solidissima*). It also feeds upon dead fish. Small specimens are frequently found resembling this species in shape, but showing three revolving chestnut-colored bands. These are now considered a variety of *L. heros*, and are called var. *triseriata.* Its egg-masses appropriately called "Sand-saucers" are quite common on the flats. The eggs are arranged in a "mass of sand glued together into the shape of a broad bowl, open

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*The writer saw last summer, at Oak Bay, a large *Buccinum undatum* which had been attacked by a *Lunatia* little larger than itself. Though the boring had not commenced, the former was completely enclosed by the foot of the latter and had its aperture quite covered with a sticky slime. It at first seemed dead, but on being placed in water revived and seemed none the werse for its adventure.

at the bottom, and broken on one side." This bowl is two to four inches in diameter. By holding it up to the light the eggs may be seen.

ECONOMICS. It does not appear that the Round Whelk is used either for food or bait, though it is probably well suited for both purposes. Willis says,—"It is slightly sought after as an article of food, and never offered for sale in any of our markets." Can any one to whom these pages may come, tell us of any other uses to which the species is applied?

It is not considered in the United States that it does any considerable harm to the Oyster-beds. Mr. Whiteaves found it on the Oyster-beds at Shediac, but we have no information as to whether it does much injury. It is eaten by several fishes.

9. **Littorina litorea** (Lin.) Forbes and Hanley.

**Periwinkle, Winkle.**

*Mic-mac* Chigujich-k.* *Acadian French,* Biourneau (?).

[*Littorina*, littus, the sea-shore; *litorea*, living on the shore.]

DISTRIBUTION. (*a*) *General;* — Between tides. Long Island Sound to Gulf of St. Lawrence.

(*b*) *In Acadia;*—(in N. B.) Bay of Fundy coast, abundant. Bay Chaleur, *Morse.* Northumberland Strait, *Dawson.* (In N. S.) North Shore, *Dawson.* Halifax, abundant, *Willis, Verkrüzen.* All rocky shores, *Jones.* (In P. E. I.) South Shore, *Whiteaves.* Large and abundant on different parts of the coast, *Dawson.* It probably occurs in all rocky situations around the entire coast of the three Provinces.

[This is now almost universally admitted to be an introduced Mollusc. Its home is in Europe and it is exceedingly abundant on the coasts of Great Britain. It was first reported from Halifax in 1857, by Mr. John Willis, but Sir William Dawson states that he collected it in the southern part of the Gulf of St. Lawrence earlier than this, and Prof. E. S. Morse received it from Bathurst in 1855. It was found near St. John by Mr. G. F. Matthew in 1861 or 1862. It was unknown on the

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*Applied probably to the native form, *L. palliata.*

coast of New England prior to 1868, but has since spread southward very rapidly, reaching Casco Bay about 1873, Cape Cod in 1875, New Haven, Conn., in 1879. The evidence bearing upon the question of whether or not it is introduced, would be out of place here. It will be found in the work by the author, cited below].

HABITS. It is not difficult to distinguish this shell from our other littoral rock-loving Gasteropods. Our native Periwinkle, *L. palliata* resembles it most closely; but that is much smaller, much thinner and lighter and entirely lacks any of the revolving raised lines so well marked in *L. litorea*. This latter character marks it off well from young specimens of *Lunatia heros*. From *L. rudis* it is separated by its greater size and, the greater number and less prominence of its revolving lines and by the shape of its mouth or aperture; in *L rudis* the latter is nearly round, in *L. litorea* it is pear-shaped. From *Purpura lapillus* and *Buccinum undatum* it is readily distinguished by the absence of a posterior prolongation of the shell into a canal. Large specimens are over an inch in length, but the average size is a little below this.

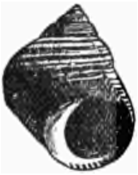

FIG. 9. — *Littorina litorea*. Natural Size.

The Periwinkle lives on the rocks between tides. It is a vegetable eater. and uses its long file-like tongue or lingual ribbon, which its relatives employ to bore through the shells of other Molluscs, for rasping up minute sea weeds from the rocks. It really grazes on these submarine pastures as do cattle on land. This mode of taking its food results in direct value to man, for in England Oyster cultivators distribute them over the beds to keep the Oysters free from seaweed. It has not been observed to attack other Molluscs. From its living on rocks between tides and possessing considerable vitality, it is liable to be taken on ships with ballast, and it was probably in this way that it was introduced into America from Europe.

ECONOMICS. This is one of the best of our Food-molluscs, a fact proven by the quantities sold both in foreign markets and our own. It is not used as yet to any extent in the United States, probably because it is of so recent introduction and because of its scarcity in the vicinity of the markets of New York—the great mollusc-market of the Eastern United States. In England there are no exact statistics to show the extent of its use, but it is estimated that in London alone more than twenty-five hundred tons, worth fifteen thousand pounds, are consumed annually. The consumption in other places is enormous also, and many hundreds of people are employed in collecting them. The average selling price is one penny a pint. It is eaten in France and probably in other parts of Europe. There, as with us, it is boiled in salt and water, and the animal extracted with a pin. In France, and perhaps elsewhere, pins are placed beside the plates of diners when these animals are served.

In Acadia our people are beginning to appreciate it. We do not know that it is as yet eaten by the fishermen, but in St. John, Mr. J. A. Turner estimates about one hundred and fifty bushels per year are consumed. Of these, a few come from Nova Scotia, but the greater quantity are collected by hand at and near Point Lepreaux. They sell for about two dollars per bushel wholesale in St. John. A few have been exported to Montreal.

It Nova Scotia, in Willis' time, twenty-five to thirty years ago, it was not used for food. At present large quantities are sold in the Halifax markets. They are gathered on the neighboring coasts and sell for five or six cents per quart. At Bedford Basin, Point Pleasant and other places, the residents on the shores gather them for their own use.

In Prince Edward Island, Mr. J. H. Duvar says it is not eaten.

It would doubtless form good bait, but is more valuable for other purposes. Its habit of cleaning sea-weeds from hard surfaces, utilized as mentioned above by oyster-culturists, may become of importance to us if there ever should be on our Gulf of St. Lawrence coast, as nature appears to have intended there should, a system of Oyster-culture.

As the Periwinkle becomes better known, it will be extensively used, and a time will come when the demand will press hard upon the supply. Though it can never approach the Oyster or the Lobster in value, we should none the less take lesson from the fate of their fishery. As Periwinkles are so small, the young are almost valueless and are hence not likely to be taken; but the reproductive season should be carefully determined for our waters, and during that time they should be left entirely undisturbed. Its abundance upon our coast will ensure a bountiful supply for some time to come.

WORKS OF REFERENCE.

Is *Littorina litorea* Introduced or Indigenous? By W. F. Ganong. *American Naturalist*, Vol. XX., Nov., 1886, pp. 931–940 and XXI., 287, 288.

## Class LAMELLIBRANCHIATA.

10. **Ostrea Virginiana** Lister.

*Ostrea Virginica* Gmêlin.
*Ostrea borealis* Lamarck.
*Ostrea Canadensis* Bruguière.

**Oyster, American Oyster.**

*Mic-mac*, Numdumoo-k. *Passamaquoddy*, Bah sapsske see zik. *Acadian French*, Huître.

[*Ostrea*, an Oyster; *Virginiana*, Virginian.]

[It is not yet known whether the Oysters of our coast are to be referred to one or to two species. Most naturalists at the present time believe the former to be the case, and this is the opinion of the writer of this paper. In any event, it does not much matter for our present purpose and we can best consider them as one.]

DISTRIBUTION. (*a*) *General;*—Shallow water. Gulf of Mexico to Massachusetts Bay. Southern part of the Gulf of St. Lawrence and waters contiguous. Formerly also in Portland Harbor, Casco Bay, etc.

(*b*) *In Acadia;*—(in N. B.) Bay Chaleur to Baie Verte, in all favorable situations. Between Caraquette Banks, Caraquette, St. Simon's Inlet, Shippegan Harbor and Gully, Tracadie, Tabusintac, Burnt Church, Bay du Vin, and many other places in Miramichi Bay, Kouchibouguac, Richibucto, Buctouche, Cocagne, Shediac, Baie Verte. (In N. S.) River Philip, Pugwash, Wallace, Malagash, Tatamagouche, River

John, Pictou, Tracadie, Mabou, Margarie, Sydney, Albert Bridge, County Harbor,* St. Mary's River*, Liscombe Harbor*, Jeddore Head,* and nearly everywhere in the Bras d'or Lakes. (In P. E. I.) All around the coast in favorable situations.

HABITS. A species, with a range as great as this, and one found under such diverse conditions, must necessarily present great variations. It would be impossible to give of it a description, either scientific or popular, which would apply to all of its individuals. Sometimes round in outline, sometimes nearly as elongated as the Razor-shell, and with every gradation between these extremes, presenting every possible variation as to convexity and corrugation of the valves, it must be considered the most variable bivalve of our coasts. Many of these variations are due to modes of attachment, overcrowding and other conditions to be considered below, but others depend upon conditions not yet understood, particularly those cases in which a certain general form is characteristic of a special locality.

The Oyster† is a bivalve, as everybody knows, with a hinge of simple mechanism at one end, so arranged as to tend to keep the shell constantly a little open. This is its position when lying undisturbed on the bottom, when weakened, or when dead. But the living animal has the power of closing the valves and keeping them closed by means of the single powerful muscle, the position of which is marked by the purple scars, known as the "eye," on the interior of the two valves. The entire interior of each valve has a rather thick, dark-edged, fringed membranous lining called the mantle, which, when fully extended, is a little larger than the valve and extends like a fringe beyond it. It is this mantle which builds the shell. That of one valve is not connected with that of the other except at the hinge and at one other point near the opposite end. Thus the animal is open or exposed nearly all around and not closed in as it would be if the mantle were almost continuous as in the Clam.

Of the two valves, one is usually flat and the other convex. The latter is the under one as the animal lies undisturbed on the bottom, and in its hollow, as in a dish, lie the other organs. The hinge is at the extreme anterior end, differing thus from the Clam in which it lies near the back of the animal. Inside the mantle, and just behind the hinge is the

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*Given by Ingersoll in U. S. 10th Census, "Oyster Fishery," on authority of *Purdy.*

†As would be expected from its great economic importance, the structure and habits of the Oyster have been very thoroughly studied, and its life history is now as well known as that of any Mollusc. Those who are specially interested will find the subject very fully treated in the works quoted at the end of this article, some of which are easily accessible.

minute mouth, guarded by four large membranous flaps, minutely striated on their inner faces. From among them, there run backwards four other larger folds, transversely striated and with crenulate edges, which follow the most curved or ventral side to the posterior margin, and around it to end near the straighter or dorsal side. These are generally known to oystermen as the "beard." They are the gills, and serve both for respiration as they do in fishes, and also to help collect the food and guide it to the mouth. Just in front of the muscle, in a cavity of its own, lies the heart, which, in a freshly-opened, healthy Oyster, can be seen to beat very slowly. It has three chambers, two auricles and a ventricle, and receiving the aerated blood from the mantle and gills, forces it through the various organs of the body, then a part of it through the gills for aeration again, and so on. The nervous system is quite simple, consisting of two ganglia or nerve-knots near the mouth which control the internal organs, and two others near the great muscle which control the latter and the mantle.

In front of the heart lies a large mass which contains the liver (a very dark brown organ), the intestine and the generative organs. At the breeding season the latter will be found very large, and filled with minute eggs or with a milky fluid (the spermatazoa), according as the animal is a female or a male. The sexes are distinct in the American Oyster, though united in the same undividual in the European species,* and there are about as many of one sex as of the other. The posterior end of the intestine is on the dorsal side of the great muscle. The water forced along by minute vibrating rods passes into the animal along the ventral margin, bathes the gills and palps and gives up to them its oxygen and food, and passes out by the dorsal margin taking with it the waste matters. The food of the Oyster consists of minute animals and plants, principally that group of the latter known as Diatoms.

It is on account of the abundance of these Diatoms on muddy bottoms in brackish waters that Oysters flourish and fatten better in such situations than in any others. They never burrow but lie upon the surface, and if accidentally covered with mud must perish. They are found also upon rocky and even sand bottoms, but they grow less rapidly and have more enemies in such places. When lying undisturbed, they are firmly attached to some support by the most convex valve; this is nearly always the left. The upper valve usually is a little lifted by the elastic hinge, and allows of the constant circulation of the water through the animal as described above. If left to themselves they grow to a great size. Specimens a foot or more in length, and about four inches in breadth being found sometimes in deep water.

The breeding habits of the American Oyster have been very carefully investigated by Professors W. K. Brooks and John A. Ryder, and their results are to be found in papers quoted below. The latter naturalist finds that about the latitude of Washington, May, June and July, are the spawning months; it is probable that in our waters it comes a little later. The eggs are about one five-hundredth of an inch in diameter, and an Oyster of average size is estimated to lay at least nine millions of them, while a very large specimen will lay several times this number. The eggs are cast directly into the water, and are not retained in the gills for a time as in the European Oyster. They can swim freely about by means of rapidly vibrating little rods or cilia, and within two or three days they develop a mouth and intestine and a symmetrical bivalve shell, and are ready to attach themselves to some clean fixed support. If the latter be wanting they perish. They are now known as the Spat, and they attach themselves usually by the left valve. They grow with the greatest rapidity, and the new growth of the valves proceeds unequally, making them soon quite unsymmetrical. In ten days they are known to attain a diameter of one-fourth of an inch, in twenty, nearly half an inch, and in forty-eight, one inch. Some specimens, not over eighty-two days old, have attained a length of nearly two inches. This rate of growth was under very favorable conditions; probably in our waters it is much slower. It is much more rapid than the growth of the European Oyster, and in nearly all respects, contrary to the general rule, the American seems to excel its European ally. In from two to three years it is ready for the market, but the very large specimens of some localities undoubtedly require from five years upwards. A warm temperature is required for the development of the young, but the adults can endure long-continued cold without injury.

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*Yet it is never self-fertilized, for the eggs and the spermatazoa come to maturity in each individual at different times.

Oysters have many enemies. Excluding for the present the greatest of all, man (his ravages will be considered below), the most destructive are the Starfishes. These animals, in a way only partially understood, can easily destroy Oysters, and the damage done by them is estimated in the United States at $200,000 yearly—more than the entire annual value of the Canadian Oyster Fishery. At Bridgeport, Conn., for instance, they destroyed over nine hundred acres of Oyster beds in less than three months, and steamers had to be employed to dredge them at great expense. They do great damage in Europe also. Next in importance comes the Drill, *Buccinum cinereum*, a description of which is given in another part of this paper. The Purple Shell, *Purpura lapillus*, the two Conchs, *Sycotypus canaliculatus* and *Fulgur carica* and some other Molluscs, and various parasitic animals do more or less damage. Upon our own North Shore, our Oyster beds are most singularly exempt from most of these foes—a subject to be again referred to a little later in this paper. Mud, sawdust, polluted water of any kind are all very fatal, but are generally due to human rather than natural agencies.

ECONOMICS. Of all invertebrate animals that live in the sea, perhaps of all invertebrate animals whatever, the Oyster is far the best known. It is very widely distributed, occurring in nearly all the seas of the globe, and there are some seventy species recognized. How far back dates its use by man we cannot say, but the shells are found in very ancient kitchen-middens or refuse heaps in America, and still more ancient ones in Europe. This rather throws doubt upon the story sometimes told that their excellence was first made known by an inquisitive walker on the seashore whose finger was pinched by one and carried for relief to his mouth. The historical accuracy of this tale is still further impugned by the fact that the same is told of the origin of several other excellent edibles.

That the Oyster is a nutritious and otherwise good article of food, all physicians, chemists and human experience agree. A discussion of its value compared with other food substances will be found in the introductory part of this paper (p. 9). It must be remembered that those tables express merely the absolute nutritive value of the various substances, and give no indication of the relative digestibility and other differences which give this Mollusc its chief value.

Though persons are occasionally found (of whom the writer is one), who dislike Oysters, we have never heard of any cases of actual poisoning by them. It is sometimes thought that those which have the gills of a green color are injurious, but repeated chemical analysis and careful experiments have shown that they are quite harmless. The green color is due to a pigment absorbed from their food, which, in such cases, consists chiefly of a particular kind of Diatoms. By feeding them other food for a time, their white color returns, and *vice versa,* by feeding white Oysters on these Diatoms they turn green. Indeed the epicures of Europe esteem the green more highly than the white, and in France there are beds in which they are carefully fed to make them green.

The United States is the greatest Oyster-producing country in the world. According to the census of 1880, this fishery is worth over $13,000,000 annually,* more than three times the value of the Cod-fishery. By far the greater portion of this is from natural beds, eighty per cent coming from Chesapeake Bay. They are exported to Canada and to Europe. There is but little in the way of Oyster-culture.

In France, elaborate systems of culture prevail, and natural beds are also extensive; the total yield is about 18,000,000 francs per year. The total yield from the beds of Great Britain is estimated at from £1,000,000 to £2,000,000 worth per year. Holland, Germany, Italy and other European countries also have their beds, but their production is of less value. The distribution of the common European Oyster (*Ostrea edulis*), seems to correspond pretty closely with the limits of those shores on which is felt the influence of the Gulf Stream.

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On the shores of Acadia, the Oyster has probably existed much longer than man. No doubt the Indians have used it from very ancient times. We are not able to find that lists of the shells of any of the Indian shell heaps † which must exist on our North Shore have ever been published, but they will surely be found to contain many of the shells of this species.‡ A single specimen was found in a shell-heap ten miles east of Halifax, and they are found in greatest abundance in the shell-heaps of Casco Bay, Maine, though the Oyster is now extinct there.

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*It has been estimated much higher than this; by one good authority at more than twice as much.

†Mr. A. Leith Adams, in his "Field and Forest Rambles," p. 35, says that he examined shell-heaps on the islands in the Bay of Fundy and on the St. Croix River, and in them occurred the Quahog and the Oyster. Other observers who have examined these shell-heaps much more carefully than Mr. Adams had done, have seen no trace of either Quahog or Oyster. Mr. Adams' error is very unfortunate; other writers have quoted and been led to wrong conclusions by him.

‡Denys seems to imply this. He says, referring to the region about St. George's Bay and the Gut of Canso, "there are found an abundance of good and very large Oysters, and of Mussels, still larger; and also an abundance of Shell-fish of all kinds good to eat, which are the most important means of subsistence of the savages during the spring."

The first European to speak of our Oysters appears to have been Champlain,* who, in "Les Voyages du Sieur de Champlain," Paris, 1613, says that in Bras d'or Lakes, Cape Breton, "there are many islands filled with a great deal of game and Shell-fish of several kinds, among others of Oysters which are not of good flavor."

The next writer to refer to them was Nicolas Denys, in his "Description Geographique et Historique . . . de l'Amerique Septentrionale," and his "Historie Naturelle . . . de l'Amerique Septentrionale," 1672. He tells us that good Oysters were found in the region of the Gut of Canso and the south shore of St. George's Bay, at Malagash, (apparently) at Pictou, at Tatamagouche and at Cocagne, and at Grand Pabou. Of Bras d'or Lakes, he says,—"There are found there only some Oysters which are not good when they are newly fished, because they are too fresh, but they have a property, which is, that one is able to keep them nine or ten days without their losing their water, after which they are salt and lose their insipidness, which is caused by the fresh water of the rivers at the mouths of which they are fished." And of Pictou River, he says,—"At a league and a half within the river, on the left hand, there is a large cove where is found a quantity of excellent Oysters; those in the passage are almost all round, and further within the cove they are of immense size; there are some found as large as a shoe and almost of the same shape, and all are very full and of good taste." These extracts are interesting, as showing that the distribution and excellence of our Oysters were known over two hundred years ago; the beds have stood a constant strain since then. Denys describes fully also the method of taking them, which will be referred to below. A few references to them occur in books of the last century† and the early part of the present, and since the publication of the first of the Dominion Annual Fishery

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*Excepting the doubtful case given on p. 5, footnote.

† A curious error occurs in a little book, entitled, "The Present State of Nova Scotia," published in Edinburg, in 1787. It says on p. 119, that Oysters have been discovered in Chignecto Bay, "and are now become an article of export to several places."

Reports, we have had constant information in the Reports of Mr. Venning, of New Brunswick, and Mr. J. H. Duvar, of Prince Edward Island, as to the condition of the beds. Mr. J. F. Whiteaves, of the Dominion Geological Survey, has given them some attention; his reports are mentioned below. In the Tenth Census of the United States, Section X., Monograph B, Report on the Oyster Industry of the U. S., pp. 3-11, Mr. Ernest Ingersoll has given a concise account of the history and present condition of the beds and a not very encouraging sketch of their probable future. Other than these we have found no writers who have discussed the Canadian Oyster-beds.

If we pass, now, from human to geological history, the first question which meets us is, how the Oysters came first to be in the Gulf, far removed as they are from their congeners to the south of Cape Cod? This problem has already been briefly discussed in the introductory part of this paper (p. 17.) But the causes which brought about the present condition of affairs are still at work, and are producing slow but constant changes in the beds. A depression of the land is certainly going on in this region and must cause changes in tides and currents, and a more active erosion * of the land and disposition of silt. To this, rather than to the action of ice, as some have thought, is probably to be referred the greater part of the destruction of former large Oyster-beds, the sites of which are marked all around Prince Edward Island especially, by immense deposits of dead shells. Oysters, though they flourish on mud bottoms, quickly perish if mud covers them.

There are other purely zoological causes also at work. The depression of the land must allow the cold waters of the deeper part of the Gulf to come nearer and nearer to the shore, making the conditions more and more favorable for the hardy northern animals, and less so for the more sensitive southern forms. The young of the latter must have warm

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*Mr. J. H. Duvar, in a letter to the writer, says:—"The Island itself is washing away at an appreciable rate,—the late Mr. Anderson, Government Surveyor, . . . told me that he had observed and estimated the decrease of the land, at one foot per annum on all its tidal margin."

water for their development. A competition must therefore be going on between the two, which can eventually result in but one way—the extinction of the southern forms.

But does this all mean, that our beds are being exterminated by a power quite beyond man's control? If so, what would be the use of Oyster-culture in our waters?

It is true that the ultimate fate of the beds is probably to be total extinction. Only a change in the present geological processes of this region, a cessation or reversal of the present sinking of the land, can save them. But it must be remembered that the whole process is extremely slow; that it takes time measured not by years but by centuries. It is so slow that for all practical purposes it is theoretical rather than real, and need not enter into the calculations of practical men. Probably, aside from man's direct influence, *i. e.*, as far as natural conditions are concerned, there has been but little change in the beds during the last two hundred years, and there will be as little more during the next two hundred. The very conditions which cause the destruction of old beds, are making new localities available. There is no doubt, that before man interfered, and to a certain extent now, new beds form in new places as old ones are smothered out; and no doubt there are, too, many places upon which new ones would grow, if tides, currents or other agency would once place oysters upon them. There is nothing, then, in the geological history of the Oyster in Acadia, to discourage systematic culture or vigorous efforts to protect and increase them

It need hardly be mentioned here, that the only Oysters in Eastern Canada are in the waters of Acadia. The following table, compiled from the Dominion Fisheries Reports, shows for a period of fifteen years, the value of the Oyster fishery to each of the provinces and to all Canada.* They are officially considered to be worth $3.00 per barrel, and dividing the value by three will give the number of barrels.

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*There are Oyster-beds on our Pacific coast, but owing to inferior quality and lack of care, they are almost valueless.

TABLE, SHOWING VALUE OF THE OYSTER IN THE THREE OYSTER-PRODUCING PROVINCES OF CANADA.

| | 1872. | 1873. | 1874. | 1875. | 1876. | 1877. | 1878. | 1879. | 1880. | 1881. | 1882. | 1883. | 1884. | 1885. | 1886. | 1887. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Brunswick, | $73,860 | $45,480 | $38,490 | $30,060 | $23,733 | $23,214 | $33,810 | $28,260 | $36,840 | $25,239 | $17,577 | $30,951 | $35,553 | $82,104 | $84,249 | $69,588 |
| Nova Scotia,..... | 600 | 36,384 | 4,026 | 4,965 | 3,120 | 2,940 | 2,754 | 3,201 | 5,583 | 6,810 | 5,235 | 4,029 | 4,785 | 3,930 | 4,191 | 5,148 |
| P. E. Island, .... | | | 256 | 82 | 23,715 | 62,550 | 53,706 | 54,435 | 60,891 | 62,445 | 171,126 | 116,640 | 84,870 | 84,612 | 99,375 | 109,344 |
| Total for Canada, | $74,460 | $82,864 | $42,772 | $35,107 | $50,568 | $88,704 | $90,270 | $85,896 | $103,314 | $94,494 | $193,938 | $151,620 | $125,208 | $170,646 | $187,815 | $184,080 |

Prince Edward Island produces the greatest quantity; New Brunswick comes next, and that of Nova Scotia is relatively insignificant. The centre of the Oyster-trade in the first of these Provinces is Summerside, and the greater part of the supply is drawn from Richmond Bay. King's County has very few or no beds. Formerly those of Malpeque and Bedeque were very productive and highly esteemed. In New Brunswick, the beds of Shediac and Cocagne have been the most famous, and were among the earliest to become exhausted. Thirty or forty years ago, those of Caraquette and Shippegan were the most productive, but to-day those of the latter place yield but few, and Caraquette and Bay du Vin give the largest returns. In Nova Scotia, the greater part are taken in the Bras d'Or Lakes, at Grand Narrows, Washabuck, Whycocomagh, River Dennis, etc., and at Tracadie, Pugwash, Wallace and Antigonish on the main land.

In Prince Edward Island, it is estimated by Mr. J. Sharp, of Summerside, that about one thousand barrels are required yearly for home consumption in the latter place, and the same quantity in Charlottetown. Considerable quantities are also consumed at other places on the Island, but far the greater portion are exported to New Brunswick and Nova Scotia, and the upper Provinces. A few are exported to Newfoundland, and lately a few to Chicago and Milwaukee.

In St. John, Mr. J. A. Turner estimates that no less than ten thousand to twelve thousand barrels of Oysters are consumed annually; of these all but about five per cent are native, the United States Oysters being imported during the close season and in the winter. The former cost about $2.50 per barrel in St. John, and the latter from two to three times as much.

In Halifax, Mr. Wilson, a large dealer, thinks that from one thousand five hundred to two thousand barrels are used annually, and about twice that quantity in the entire Province. About one-tenth or less of these are United States Oysters; the remainder are the greatly preferred natives. The latter cost about two dollars and fifty cents to importer and three dollars per barrel to the consumer, while the former cost from five dollars per barrel upwards, and are imported chiefly in the winter.

All agree, that price and other conditions being equal, our native Oyster is preferred to the imported, on account chiefly of its better flavor.

We have not been able to prepare statistics to show the value of the importation of United States Oysters into Canada. But it is enough to say that Canadian beds do not produce nearly enough for Canadian needs, and not too much to say, that Canadian beds are capable of supplying Canadian needs and much more, if properly managed.

The immense fertility of the Oyster can find no more forcible illustration than the above table. That in the face of reckless and unrestrained over-fishing, destruction of the young, polution of the water by mills, and, in a measure, by mud-digging machines, cutting to pieces of the beds by the latter, disregard of the spawning season and other grievances, the Oyster-yield should be actually increasing is surprising enough. This continuation of the supply, however, has been in great part due to the discovery of new beds as old ones became exhausted, and the utilization of previously known but inferior ones; but we must now be well nigh their end. It is interesting to note, as one must in looking over the Fishery Reports, how the point of greatest productiveness has shifted about during the past fifty years. Our beds have always been considered public property,* to be fished by anyone and his neighbor, and laws for the rational protection of the fishery have been imperfect or provided no means for their own enforcement.* There is by law a close season, from June 1st to the 15th of September, but is only partially observed. The true condition of affairs has been repeatedly pointed out by the Fishery Inspectors, and remedies suggested by them. Mr. W. H. Venning, Inspector for New Brunswick, has urged year after year the necessity for government interference, and Mr. J. H. Duvar, Inspector for Prince Edward Island, in his very full reports for 1880-87 has repeatedly summarized the whole matter. To the easily accessible reports of these two Inspectors,† and to that of Mr. Whiteaves, all mentioned below, those interested in the subject should turn.

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*Denys' description of the mode of taking the Oyster prior to 1672, is not only interesting in itself, but in many respects would stand as a description of operations to-day.

"I have spoken of Oysters in the first book, but I have not told you that they are a great manna for the winter, when the season does not allow of going a-fishing. They are in the coves or on the coast near the land. To get them, the ice is broken, a large opening is made; then are provided slender poles long enough to touch the bottom. Two of them are bound together about the middle, then they are opened and closed like tongs. They are taken from the water and thrown upon the ice. This fishing is never resorted to unless there are several persons; some fish, another makes the fire, another shells them for frying, others place them on the coals, two or three in a large shell, with their water, with crumbs of bread and a little pepper or nutmeg. They are cooked like this, and it is a good feast, and when they are well filled, each one takes his load, and the dogs draw, each one a bag-full on a little sled, which is made very light for them; harnessed like a horse they go always running over the ice or snow; they are the ones which carry all the equipage of the hunters."

Oysters are still taken in Acadia by tongs or rakes. The dredge is never used.

In Prince Edward Island, and to a certain extent in the other Provinces, the value of Oysters as food is rivalled by the value of their shells as a fertilizer. In the estuaries are immense deposits of dead shells, the remains of old beds killed by silt or other causes. These are mingled with fine rich mud and decomposing animal and vegetable matter, forming a muck of the richest character. Before the plough the shells break up and give the land the lime in which Prince Edward Island is very deficient. This mud is known as Mussel-mud, though in most cases it consists almost entirely of Oyster-shells. It is taken by large machines worked on the ice by horses. As to its value, Mr. J. Hunter Duvar, in his report for 1879, says:—"The digging of Mussel-mud for manure—Mussel-mud being the shells of old Oyster-beds—is very harmful to the live beds, but it is scarcely to be doubted that the benefit to the country is of more absolute value than the preservation of the Oyster;" again in 1880, "It is not saying too much to assert that the product of grass and grain has been increased one-third by the use of this mud during the few years since it began to be generally made use of." It is clear, as there is other testimony also to show, that the protection of the Oyster must be so managed as to allow of the taking of the Mussel-mud by the farmers.

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* Mr. J. H. Duvar writes,—"In the present unsatisfactory and muddled state of the Oyster-law in Prince Edward Island, nobody will risk private Oyster-beds, but I have on file over thirty applications for sites for culture so soon as the Department will decide on places."

†Those of Mr. Duvar, especially, are admirable expositions of the state and needs of the Canadian Oyster-fishery, and have been much consulted in the preparation of this paper. They are written by one personally familiar with the subject.

There are two futures open to the Oyster-industry of Acadia; free fishing by the people and a lingering death, or vigorous government interference and a great and lasting prosperity. This is the kernel of the whole matter—government interference. It has worked well in other countries; it would, under the same conditions, work well in this. The duty of the government, if it take charge of it, would be two-fold,—to regulate the fishery on the public beds and to give encouragement to culture by corporations or individuals. As to the first, the position and extent of beds must be determined, and each one given a period of rest, being fished not oftener than once in three years; the close season should be vigorously enforced; fishermen must, under heavy penalties, return to the water all Oysters under a certain size; mud-machines must be restricted to certain places in each district, being given ample liberty but not allowed within a certain distance of any living bed; mills must not be allowed to discharge sawdust into the water within a long distance of a living bed; fishing through the ice should be regulated so that refuse cannot be allowed to fall on the beds. As to the encouragement of culture, laws should be enacted which would give to a culturist as good a right to his product, and as full protection from theft, as has a farmer. Areas in good localities should be set aside and leased for long periods, but as a rule the public beds should not be trespassed upon. Some beds should always be reserved for public fishing; freedom to take wild game under common sense conditions, the Dominion should be very slow to take from its citizens. Private individuals should be encouraged to take their seed-oysters from our own beds, as there are none better nor so good for our climate. A measure which might be needful would be the appointment of a commissioner, who should be a man trained in the best methods of culture of Europe and the United

States, who could give his whole time to the work; who could not only scientifically investigate the needs of our own region, but also direct the work of private culturists.

Oyster-culture has been tried in Acadia, but under many discouragements. Hon. Mr. Pope, in Richmond Bay, Prince Edward Island, and Hon. Mr. Macfarlane, in Wallace Harbor, Nova Scotia, have had moderate success.* It has been tried, too, as Gaspé, at Bic and at Seven Islands, in Quebec, and in Passamaquoddy Bay, but these are outside the range of the Oyster, and where the temperature is too low in summer for the development of the young.

It is to systematic culture that the Oyster-industry must look for its future. France leads the world in Oyster-culture, England and Germany are far behind, and the United States comes last of all. This whole subject is too vast to be more than alluded to in this paper, but references to the more important works will be found below. Oyster-culture is carried to greatest perfection at Arcachon, in France. There are used elaborate means of arresting the Spat or young by providing clean, hard supports to which they may attach themselves. The latter are either tiles, faggots, old shells strung on wire or other similar devices. As soon as the young are from half an inch to an inch in diameter, they are removed and placed in artificial ponds in which their growth is carefully watched until they are marketable, which occurs in from two to three years. They are usually fattened in special ponds. From this high state of culture down to the simple removal of the Oysters from the natural beds to places favorable for fattening or bloating them (as the case may be) for the market, there is every gradation. A thorough knowledge of the subject is a study for a lifetime, a profession in itself.

There is no doubt that the coasts of the Acadian Oyster-region are extremely well adapted for Oyster-culture. Almost everywhere around Prince Edward Island and the New Brunswick coast are shallow salt lagoons as well as many places where artificial ponds could be cheaply made. It has been proven by Prof. J. A. Ryder, that they can be raised in shallow ponds from artificially hatched eggs in the United States, and there is no reason to suppose that the same would not be possible with us. Seed-oysters of the best quality are at hand in the old beds. Another circumstance of the highest importance is the scarcity of Oyster enemies on our North Shore. The Starfish, which does annually more damage to the beds of the United States than the entire Canadian fishery is worth, is rare and does little damage on the North Shore. One old oysterman of Shediac told Mr. Ingersoll, of the United States Census Staff, that he had only seen three Starfishes in his life. The "Drill" (*Buccinum cinereum*), though present not common. Mr. Whiteaves did not find it at all in his examination of the Shediac beds. The same may be said of the Purple-shell (*Purpura lapillus*), another enemy; it is present but rare, and was not seen by Mr. Whiteaves. The writer has made a careful examination of a large box of mud from the North Shore beds, which was taken from the barrels containing Oysters. In this, among the two dozen or more species and hundreds of individuals of Molluscs which live with the Oyster on the beds, not a single specimen of either of these species was found. Again, on the coast of the United States, two very destructive animals are the two Conchs or Winkles, Gasteropod Molluscs several inches in length, the *Sycotypus canaliculatus* and *Fulgur carica*. These are entirely wanting in the Gulf of St. Lawrence, and if our beds are planted from our own, as they should be, there is no danger of their introduction. It surely must be an immense advantage to any culturist in our waters, that some Oyster-enemies are comparatively harmless and others entirely wanting. Doubtless, the reason for the scarcity of the above forms is due to the generally sandy character of the region, most of them being rock-loving species. Tiles for Oyster-culture could be made as cheaply in these Provinces as in the United States, and it is possible that some of our slate rocks could be utilized for this purpose. Many other minor conditions are also favorable, and there is an immense market both in Canada and the United States, for many times the quantity now produced.

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*Mr. J. H. Duvar recently told the writer that,—"Messrs. Pope's Oyster-farm, at Squirrel Creek, Richmond Bay. . . . is still in profitable existence. W. A. Pope died and the property went to his brother, Hon. J. C. Pope. . . . . Later, the Oyster-lot lay vacant for a long time, until bought last year by Mr. Richards, who works it profitably."

The Oyster has but few uses aside from those mentioned. Its shells are used in Oyster-culture, to spread on the beds for the young to attach themselves to, and they are also much used in road-making in parts of the United States, and they have even at times been burned for lime.

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11. **Pecten tenuicostatus** Mighels and Adams.

*Pecten Magellanicus* Lam.

**Smooth Scallop, Scallop.**

*Mic-mac*, Sakskataas-uk. *Passamaquoddy*, Sah quitook yik.

[*Pecten*, a comb; *tenuicostatus*, slender-ribbed.]

DISTRIBUTION. *(a) General;*—Extreme low-water mark to one hundred and nine fathoms. New Jersey (rare south of Cape Cod) to Labrador.

*(b) In Acadia;*—(in N. B.) Grand Manan, ten to twenty fathoms, rather rare, *Gould.* Passamaquoddy Bay and Bay

of Fundy, common, one to one hundred and nine fathoms, *Verrill.* St. Croix River, near Dochet Island, not plenty, *Fuller.* L'Etang and Chamcook Harbors, abundant in former, *Ganong.* Mace's Bay, *Perley* and *G. F. Matthew.* Northumberland Strait, *Whiteaves.* Between Tracadie and Shippegan, *Perley.* (In N. S.) Bay of Fundy Coast, large, *Verkrüzen.* Bear Island Bar; Annapolis Basin, extensive beds, *Perley.* Bedford Basin and Halifax Harbor, *H. Piers.* Whole coast, *Jones* and *Willis.* Prince Edward Island, *Dawson.* Probably not so abundant in Gulf of St. Lawrence as in Bay of Fundy and on the Atlantic coast.

HABITS. This is one of the most attractive Molluscs of our whole coast. Its smooth, nearly circular valves, one flat, the other convex, and its large size (five to six and even eight, in an extreme case, inches in diameter) will readily distinguish it from any other species in our waters. The under or flat valve is very smooth, free from parasitic growths and of a white or cream color. The upper, usually of some reddish color, while free from the pronounced ribs that so many of this genus have, frequently bears many parasitic forms, Barnacles, Bryozoa, etc. Very many have this valve covered with a gelatinous coating which can be easily removed; this is not an epidermis, but colonies of compound Ascidians of the genus *Leptoclinum.* It is really a beautiful shell, the interior being smooth, white and satin-like; the exterior, especially in young shells, presents delicate and attractive colors, some of them showing beautiful pink and white radiations; while its valves can be utilized for many decorative and artistic purposes.

Our Scallop lives upon hard, sand, or mud bottoms, feeding upon microscopical animals and plants. It has the advantage over all others of our shelled Molluscs in the ease and speed with which it can move about. The powerful adductor muscle can bring the valves together with great force and quickness, ejecting the water on the side opposite the hinge, and thus shooting the animal several feet in the opposite direction. The young Scallops can swim in this way better than the adults, their shells being much lighter. The southern *Pecten irradians* often swims in schools, all together in some definite direction, but we do not know that this has been observed in the species we are considering. The young are eaten by cod and probably other fishes.

ECONOMICS. Our Scallop is not the species which is of so much commercial importance in the United States. The latter is a much smaller species, *Pecten irradians,* the shell of which is covered with very large radiating ribs. But those who have tried them declare that our Scallop is quite as good food as is *Pecten irradians.* In all probability, methods of capturing, preparing for market, utilization of shells, etc., of the latter would apply equally well to our species.

*Pecten irradians* is taken on the coast of the United States between Cope Cod and New Jersey. It has been found within the limits of Acadia also, at Sable Island. But it is too rare to be of any commercial value with us. The annual value of the fishery to the United States is about $28,000 to $29,000, this being the price received by the fishermen for from 70,000 to 75,000 gallons of the edible parts. The fishery gives employment to about 250 men and 470 women and children. Mr. Ingersoll, in the paper referred to below (a full and interesting treatment of the subject) says of the mode of taking them,—"Scallops are caught by hand-dredging from small sail-boats. The dredges are about thirty inches in width, have a scraper-blade upon the bottom, and in favorable weather several may be thrown over from each boat. In shoal water an iron-framed dip-net is sometimes used on calm days. It is pretty hard work, and entails exposure to very severe weather." The only part ever eaten is the large muscle which closes the valves. These are cut out, cleaned and sent to market where they are sold by the quart. All other soft parts are utilized for fertilizers, while the shells are valued, above all others, by Oyster-culturists for catching the Spat or young Oysters. Their special fitness for this use comes from their fragility and rapidity with which they fall to pieces under the influence of decay and boring parasites. The young Oysters fall apart as the shells break, and overcrowding, dwarfing and distortion is thus prevented. They become full-grown in little over a year; those born in June of one year being full-grown by the following October and at their best in December. The flesh, while very agreeable to some persons in spite of its sweetish taste, is to others not only disagreeable, but actually injurious, producing sickness.

So much for a southern species. How does our native Scallop compare with it in the particulars above mentioned?

In the work by Mr. Ingersoll, quoted below, he says,—

"The great *Pecten tenuicostatus* on the coast of Maine and the Bay of Fundy, was formerly highly valued by the people of that region, but now is too scarce to appear on the tables of even 'the rich' except at rare intervals." . . . "The huge, smooth-shelled *Pecten tenuicostatus* of the north, as big as a fruit-plate, which formally abounded on the coast of Maine, has now become so rare as to be a prize in the cabinet of the conchologist rather than an edible commodity—a result unquestionably due to over-greedy catching." We believe that while the case here stated may be true for the Maine coast, it is not so for New Brunswick and Nova Scotia. Large numbers of them still live in L'Etang Harbor and other inlets both on the New Brunswick and Nova Scotia shores of the Bay of Fundy. From the former locality large quantities are occasionally brought in schooners to St. John.

Mr. Willis, thirty years ago, said it was common on the whole coast of Nova Scotia, and that it "furnished the residents of Lunenburg, Mahone Bay, Chester, etc., with many a rich treat. In these localities it is said to be very abundant, and more easily obtained than in most other parts of the Province." Nicolas Denys knew of their abundance there, for in 1672, he says of La Have Harbor,—"In which there are countless numbers of Scallops [Conniffle], which are great shell-fish like those which the Pilgrims bring from St. Michael and St. James. It is excellent eating." The fishery returns for Nova Scotia give the only official notice of Scallops which are given for any of the Provinces. That of 1886 gives 300 dozen Scallops as taken in Lunenburg County, worth fifty cents per dozen, or $150; that of 1887 gives for the same county 600 dozen, worth $300. In New Brunswick, a schooner occasionally brings a quantity to St. John from L'Etang Harbor or Mace's Bay where they are taken by dredges, and they are sold direct from the vessel. The quantity thus sold is estimated to be about two hundred bushels annually. It is frequently eaten by the fishermen of the Charlotte County coast. In the Halifax market, not many are sold. The usual price is fifty cents per dozen, but not infrequently they bring much more. In Prince Edward Island it is sometimes eaten, though according to Mr. J. H. Duvar, it is not much esteemed there. It can be taken, he says, in moderate quantity. No Scallops are imported from the United States into Acadia.

As to the value of our species for food, as compared with the southern form, the testimony is all one way. Mr. Willis says that it, and the species next to be described, *Pecten Islandicus,* were considered delicacies in Nova Scotia, and that he had known them, when offered for sale, to sell readily for one shilling sterling each. Mr. Ingersoll, as mentioned above, refers to its excellence, and persons who have tried both have assured the writer that our Scallop is quite as good as the southern form. It has the advantage also of being larger than the latter. The muscle, the only part eaten, must be twice the size.

The shells are made useful for many purposes, and here, again, our species has the advantage. The valves are frequently used as dishes in fishermen's families, and even by professional cooks. Indeed, it is said that, "From its use, by cooks now, this shell [*i. e.*, Scallop shells in general] has given the name to 'Scalloped' oysters." The valves of the young of this, and those of the following species, are made to form part of pin-cushions, needle-books and other like ornaments, while the entire valves are sometimes used as mantel ornaments. The smooth, satin-like interior faces, particularly of the flat valves, take both oil and water colors well, and frequently are used as placques for painting upon. Their use by Oyster-culturists has been already referred to, and our species ought to be even better adapted for this purpose than *P. irradians.* No doubt there are many other minor uses found for this attractive shell.

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### 12. **Pecten Islandicus** (Müller) Chemnitz.

**Scallop, Iceland Scallop.**

[*Pecten*, a comb; *Islandicus*, Icelandic.]

DISTRIBUTION. (*a*) *General;*—Low-water mark to one hundred fathoms. Cape Cod (very rare to the south of it) to the Arctic Ocean and around the North Atlantic to Northern Europe and Great Britain.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, twenty-five to forty fathoms, shelly bottoms, *Stimpson*. Common in Bay of Fundy, low-water mark to one hundred fathoms, *Verrill*. L'Etang Harbor, large, though not abundant, *Ganong*. (In N. S.) Annapolis Basin, few small specimens, *Verkrüzen*. Whole coast, *Jones*. Halifax Harbor, *Willis*. Not yet reported from Prince Edward Island. [Rev. George Sutherland, in his Natural and Civil History of Prince Edward

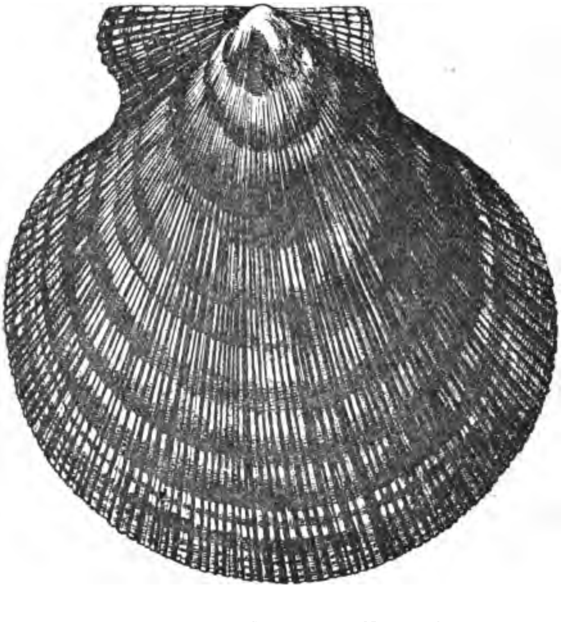

FIG. 10.—*Pecten Islandicus*, Natural Size.

Island, 1861, mentions Scallops, "with large ribbed shell, and serrated edge," as occurring on the coast of Prince Edward Island. This description would apply both to this species and the following, but better to the latter than the former.] Probably rather common on Bay of Fundy and Atlantic coasts, and much less so in the Gulf of St. Lawrence.

HABITS. This is a more northern species than the last and less abundant in our waters. It is much smaller than the latter, rarely exceeding four inches in diameter and is readily distinguished from it by its raised radiating ribs, fifty to one hundred in number, which bear closely crowded, transverse, erect scales. The "ears" or triangular projections from the valves which form the hinge, are unequal in size and shape in this species, though equal in *P. tenuicostatus*. In habits it appears to resemble the latter very closely, living in perhaps more rocky situations, but moving, taking its food and so on, in the same way.

ECONOMICS. In its usefulness to man, this species cannot be distinguished from *Pecten tenuicostatus*. It is equally good for food and its shells may be used for the same purposes. Willis tells us that he has known it to be sold with the latter for one shilling sterling, each, in the Halifax market, and that it is quite as delicate food. Its greater scarcity must make it much less valuable. It is probably never taken separately from its larger relative, and is not distinguished from it by the fishermen.

### 13. **Pecten irradians** Lamarck.

*Pecten concentricus* Say.

**Scallop.**

[*Pecten*, a comb; *irradians*, radiating.]

DISTRIBUTION. (*a*) *General;*—Low-water mark to thirty or forty fathoms. Gulf of Mexico and Florida, north to Massachusetts Bay. Sable Island.

(*b*) *In Acadia;*—Reported only from Sable Island, by John Willis.

HABITS. This is the Scallop which is of so much importance in the United States markets. As it is so rare in Acadia, indeed hardly coming within the limits of this paper at all, it is not thought best to describe it in detail. When found, it may be distinguished from our two Scallops described above, by the coarse radiating ribs, about twenty in number, and the nearly equal "ears" or lateral projections from the shell, forming the hinge. Its habits resemble those of *P. tenuicostatus*, described above. It is possible that it may be found in the Gulf of St. Lawrence along with the southern shells there, and if not, it is extremely probable that it would flourish there if introduced. Indeed, as mentioned under the last species, a Scallop having a "large ribbed shell and serrated edge," has been described as living on the shores of Prince Edward Island. It may be not improbably this species.

ECONOMICS. Its use to man may be best described in connection with our native Scallop, as both are available for the same purposes.

### 14. **Mytilus edulis** Linnæus.

**Edible Mussel, Black Mussel, Sea Mussel.**

*Mic-mac,* Angadaalow, *pl.* Angadaalak. *Passamaquoddy,* Sah tah sis ik.

[*Mytilus*, the ancient Greek name; *edulis*, edible.]

DISTRIBUTION. (*a*) *General;*—Littoral zone to more than one hundred fathoms. North Carolina to Arctic Ocean and circumpolar. On European coast, southward to Mediterranean and Black Sea; on Asiatic coast to China and Japan; on Western American coast to California.

(*b*) *In Acadia;*—(in N. B.) Exceedingly abundant everywhere on the southern coast from Grand Manan to St. John, and probably much further. Bay Chaleur, *Bell.* Shediac, *Whiteaves.* (In N. S.) Annapolis Basin and Digby Gut, common, *Verkrüzen.* Whole coast, *Jones.* Prince Edward Island, *Dawson.* Very abundant everywhere on the coast of Acadia.

HABITS. Without doubt, this is the most common and abundant Mollusc on the coast of Acadia. There is probably not a mile of shore on our whole coast line which is without it, and everybody who visits the sea-shore must know it well. There is only one common Mollusc at all likely to be mistaken for it—and that is the Horse-mussel, *Modiola modiolus*. But the former is blue-black generally, and the latter is chestnut, or rather its epidermis is, and their situations or habitats are different, as will be seen by reading the descriptions of both. A good mark to separate them is found in the position of the umbo, or raised knob around which the concentric lines of growth of the shell are arranged; this is at the extreme end in *M. edulis*, but set a little back near one margin in *Modiola modiolus*. Its lack of raised ribs distinguishes it from *M. plicatula*.

This species varies somewhat in color, the variant individuals being of a darker or lighter horn-color, and generally showing radiating, longitudinal, dark lines. These forms are by some considered to form a distinct variety—to which the name *pellucidus* is given. Within, the shell is dark-violet, silver and white, and often very beautiful. The average length of adults is about three inches, though they grow as great as five, and even over eight inches in rare cases in Europe. They vary greatly in outline, the nature of the variation of an individual depending chiefly upon the conditions under which it has grown.

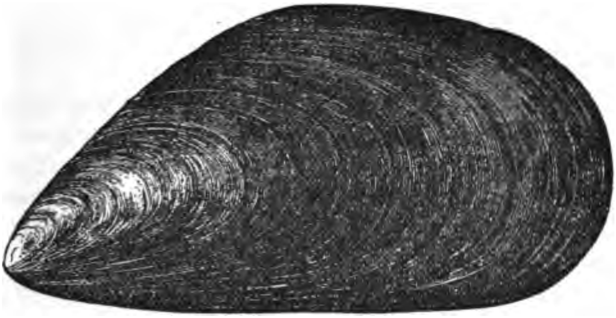

FIG. 11.—*Mytilus edulis*. Natural Size.

It is a fact of no little importance to man, as will be presently seen, that the edible Mussels are gregarious. All visitors to the shore remember well the great beds, often acres in extent, which are found on the flats, especially of estuaries. They never burrow, but instead, fix themselves by means of a mass of silky threads which are secreted by the foot and pass out between the valves. With these they can attach themselves to any surface, sand, mud and gravel, rocks, piles of wharves, buoys, bottoms of boats, and, in fact almost anywhere. They prefer, however, mixed gravel and mud flats where the water is not quite pure, but has some admixture of river water. The mud flats they add to, both by collecting sediment among themselves, packed closely together as they are, and by their own decay and decomposition. The beds are found both between tide-marks and in shallow water, and the latter produce the larger specimens. Indeed, the largest are found isolated, for the crowded, tangled mass in the beds does not allow of large growth.

Though ordinarily fixed by the byssus, they can travel a little when needful. The foot is thrust far out in advance to attach new threads by which it draws itself along, breaking off the old ones behind. It lives upon microscopical animals and plants, chiefly upon the latter. It has some enemies, chief among them, the food fishes, all of which are exceedingly fond of it. Crows, the Purple-shell (*P. lapillus*), the Star-fish, and (in England) the Sea-urchin, all are destructive to it.

The height of the reproductive season appears to be April and May. The young, after leaving the body of the parent, swim about for a few days and then settle upon some firm surface. They grow very rapidly; there are cases known in which they have grown to full size (three to four inches long), in one year. In most cases, however, they require two or three years.

ECONOMICS. Our edible Mussel is, without any question, identical in all respects with that of Europe. And without any question, also, it is adapted for the same uses. In Europe, the uses to man of this species may be roughly classed under four heads, the following being their order of importance.

*a.* As bait in the fisheries.
*b.* As human food.
*c.* As a fertilizer.
*d.* Minor uses for ornaments, etc.

In America the order is quite different. The third in the list certainly stands first, but it is difficult to state the order of the other three, which apparently stand about on an equality. In Europe, it is a Mollusc of great importance, being second only to the Oyster; we almost ignore it. There, it entirely replaces our common Clam, which, though abundant, is rarely used either for food or for bait. Is it not a curious fact that each country should prize the one the other neglects? Why do they not each value both? It would be interesting to learn how this condition of affairs came about in this country; in other words, how the early settlers, always conservative of old customs, and used to European ways, abandoned them and took to new? Did they imitate the

Indians, who, we know, used the Clam to the almost total neglect of the Mussel?* And are not the Europeans of to-day wiser than we in this respect, that they use a form, which, equally good with the other, lives on the surface and can be easily gathered, and besides is susceptible of easy artificial cultivation anywhere, while we take that for which we must laboriously dig, which requires more special conditions of soil, and which, only with difficulty, can be artificially propagated? A consideration, therefore, necessarily brief, of the economics of this species in Europe, may suggest some useful lessons to us.

### (*a*) ITS USE AS BAIT IN THE FISHERIES.

We are told of its use in England (Fisheries Literature) that,—"The Mussel is admitted on all hands to be the most deadly bait for salt-water fish;" and again,—"The Mussel is perhaps the best kind of hook bait known." What have our fishermen, who use the Clam and the Squid, to say to this?

In England and Scotland it is especially valued, and it is estimated that no less than the enormous quantity of one hundred thousand tons annually are required for this purpose in Great Britain alone. The single port of Eyemouth required for its fishing vessels during the season of 1881–82, eight hundred and ninety tons of Mussels. Three Scottish villages have been known to use, in one week, sixty-one tons.

These figures will show what an enormous drain upon the Mussel beds of Britain there must be for this purpose alone, not taking into consideration those used for food. It has been too great for the natural product, and the fishermen have been forced to importation and to artificial cultivation. In 1881, twelve thousand tons, mostly for bait, were imported from Holland into England.

They are gathered by those who make a business of it, by hand, when above low-water mark, and by a sort of grapnel-dredge when below it. They are taken to the fishing grounds alive (our fishermen take their Clams and Squid salted), and they will remain so for some hours (one writer says for two days), when placed on the hook and suspended in the water. It is thought that this fact is the chief element in its success as a bait. It is used for all kinds of fish which bite at a hook, cod, haddock, etc., and although in deep water and far from land, Whelks (*Buccinum undatum*) are sometimes preferred, the Mussel is much the best all-around bait. The Swedish fishermen use it in preference to all others, as probably do other European fisher-peoples.

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* As shown by the Indian shell-heaps. Lescarbot (1609) corroborates this in the following,—"But yet they [*i. e.*, the Mic-macs] have a superstition, not to wish to eat Mussels. Yet they cannot give a reason for it. . . . . . Nevertheless in our company, seeing us eat them, they did likewise."

In the United States we cannot find that it is ever used for bait, nor in any part of Canada, except very rarely and locally. In Acadia, we do not know that it is ever used for this purpose;* can any one tell us the reason? It is more abundant and more easily obtained than the Clam, has a lighter shell, is easier to open, is probably more tenacious of life, and has other apparent advantages.

### (*b*) ITS USE AS HUMAN FOOD.

Of all European countries, France probably uses the most Mussels for food. In 1873, the fishery was estimated to be worth $160,000, in part from natural and partly from cultivated beds. Belgium also produces many, and it was estimated in 1873 that there was exported from Antwerp to Paris alone £280,000 worth, all taken from natural beds. From many parts of the English coast they are sent inland, where they are eaten in all towns, but the greater supply for the London market is imported from Holland. In London, £4,000 worth are sold annually for food, at a price of about one penny per quart, ranking in value as the third shell-fish, the Oyster being first, and the Periwinkle second. Statistics for the whole of England are wanting, but the quantity must be enormous. It is used largely as a substitute for Oysters—in making fish-sauces, and is also cooked in other ways. In

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*** As this paper is in press, Mr. H. Piers writes the author that on the Atlantic coast of Nova Scotia, " they are not sold for bait, but are occasionally used by the fishermen when nothing better can be had."**

France, they are considered good throughout the year, but at their best in August and September.

In the United States, New York is the centre of its use as food. Considerable quantities are there pickled and sent inland. The total annual value of the Mussel fishery in the United States is estimated at about $37,500, but of this a small part only is for its use as food; its chief value is as a fertilizer.

In Acadia, it is but little used for food. It is very rarely used by the fishermen, and is quite unknown in the markets of St. John. In Halifax, Willis said of it thirty years ago, that it could be purchased in the markets when in season, of large size and fine flavor, for about two shillings sterling per bushel. It is still sold in the Halifax markets, though in small quantities. The usual price is ten cents for a half-peck, or about fifty or sixty cents a bushel.

In Prince Edward Island it does not appear to be used at all for food.

As to its general excellence as an article of food there can be no question. Some tables, to show its value compared with other shell-fish, will be found in the introduction (p. 9). In Europe, it is eaten by all classes, but is especially a luxury of the poor. Gould says that he has been "assured by a friend of acknowledged good taste, that when cooked it is more palatable than the common Clam;" and in this opinion many others will concur. But at the same time, it is undoubtedly true that there are persons who not only dislike them, but to whom they are very injurious. Each person must determine this for himself, using them at first with caution.*

It is true, also, that in addition to this occasional constitutional danger, Mussels are sometimes, though very rarely, really in themselves poisonous, and injure everybody who may eat of them. Such cases, however, are no more frequent than poisoning by eating partridges in the spring is with us, and not nearly so frequent as is poisoning from eating canned fruits and meats. This, therefore, should be no hindrance to their use, proper precautions being observed.

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* The symptoms, which must serve as danger-signals, are great swelling in the head and the abdomen and the appearance of red spots on both.

As to the cause of the poisoning, we have not perfectly satisfactory knowledge. In general, it appears to be due to the exposure of the Mussels to impure waters. Some years ago a case of violent poisoning in Wilhelmshaven, in North Germany, which resulted in the death of several persons, led to a careful investigation. It was shown that the fatal Mussels had been taken from the harbor of the town, in which the water, though salt, is quite stagnant, clear water entering in small quantities at high tide only. Fish could not live in it, and even the all-enduring eel became weak and helpless. Experiments proved that all the Mussels of the still water were poisonous, but that upon being removed to clear water they quickly became harmless; on the other hand, perfectly good Mussels, placed in the harbor, were soon very poisonous. Prof. Virchow found that only the liver contains the poison, and that it can be rendered harmless by cooking the animal in a solution of soda. The best antidote is said to be a quantity of milk. The safest way, according to this investigator, is to remove the liver from every specimen to be eaten. It is a large yellowish-brown soft body enclosing the stomach on the upper side, and involved in numerous loops of the intestine. The conclusion to be drawn from these facts is, that Mussels from stagnant or impure waters should always be avoided, and everybody ought, before eating them, to know whence they came. It is thought, too, that they may be injurious when taken from docks in which copper-bottomed ships are moored, or from harbors in which there are mineral lodes exposed to the action of the water. Several writers have thought that the striped variety (*var. pellucidus*) is poisonous. As mentioned above, however, these cases of poisoning are very rare, and should prove no impediment to their free use, proper precautions being taken to bring the supply from pure waters.

### (c) ITS USE AS A FERTILIZER.

When a great bed of Mussels is exposed on a flat in an estuary, it is constantly catching the fine silt which the fresh water deposits when it meets the salt. The animals live their short lives, die, and are buried beneath their progeny. The lime of the shells, their animal matter, and the rich silt, go on accumulating, and soon form a mass of the richest fertilizer.

In Europe this fact has been fully recognized, but there the living Mussels are far too valuable to be used to any extent for this purpose; so valuable, that it has been proposed in England to make it a penal offence to take them for manure. The latter step is necessary because of the nearsightedness of the farmers, who would totally exterminate them if allowed.

In the United States, it is taken along the coasts of Long Island and New Jersey in enormous quantities for this purpose, though it does not seem to be much used farther north. Its value to the United States is estimated at $37,500 yearly, nearly all of which is for its use as a fertilizer.

In Acadia, all have heard of the "Mussel-mud" of Prince Edward Island and the North Shore of the two other Provinces. A large part of the Mussel-mud, however, probably very much the largest part, consists of the remains of the Oyster. The subject has been considered at some length under that species. We have found no evidence to show that the Mussels are taken separately for this purpose.

Upon the Bay of Fundy coast, the farmers make but little use of what would appear to be a mine of agricultural wealth at their very doors. Everywhere about Passamaquoddy Bay there are great beds, the use of which ought greatly to benefit the land.

### (*d*) OTHER MINOR USES.

In England, it has been proposed, and it would be equally applicable in this country, to plant Mussels on breakwaters of gravel and other shifting substances, and upon beaches exposed to the wearing action of the waves, in order to bind them together, just as beach-grass is used on the sand-dunes of Cape Cod. They would quickly fix themselves, and by their tough, interlacing, tangled byssi or beards would soon form a tough but elastic coating.

It is thought also that they can be used to prevent the ravages of *Teredines* or Ship Worms on timber of wharves and the like, by coating the latter completely.

Pearls of some beauty are not infrequent in these Mussels, but they are rarely large or perfect enough to be of value. Forbes and Hanley say,—"They are commonly small, ill-colored, and of little value, yet have been at various times much sought for." They have brought from one shilling and sixpence to four shillings per ounce. In the "First Report on the Fauna of Liverpool Bay," p. 241, we are told, —"Some years ago, large quantities of Mussels were raked up in Conway Bay, and boiled in huts on the east shore to get seed pearls. These were bought by a traveller at four shillings per ounce. A woman could earn twelve shillings per week at this harvest. The trade has ceased." Sometimes the whole interior of the shell is covered with little pearl-like excrescences, the result of the efforts of the animal to protect itself from a boring sponge.

Simmonds, in "Commercial Products of the Sea," tells us of the shells,—"When polished, they are made into pretty needle-books and scent-bottle holders, earrings, crosses, pins and pin-cushions. They are mounted on marble as paper weights, and are used as a receptacle for gold and silver paint for artists. The Maories of New Zealand employ Mussel shells as tweezers to eradicate the hair from their faces." Mr. Ingersoll says the American Indians also used them for the latter purpose.

The shells are also spread on Oyster-beds by cultivators, as a support to which the young Oysters may attach themselves.

## ON MUSSEL CULTURE.

As in the case of the Oyster, the demand for Mussels in Europe is far too great to be supplied from natural beds. Extensive cultivation is the only remedy, and in this France leads all other countries. A full treatment of the subject, for which we have not space here, will be found by those interested, in the volumes of the Fisheries Exhibition Literature and other works quoted below. A very brief outline must suffice here. There are two modes of culture practised in Europe; one known as the British method, in which young Mussels are taken from salt or nearly salt water and transported to the banks of estuaries where they are exposed for a time at low tides, and where the water is brackish. Both these conditions seem to be necessary to secure their rapid growth and fattening. The presence of some fresh water is a necessary condition to success in Mussel culture. The French method proceeds upon a different principle; it consists in placing convenient supports for the Mussel "Spat," or free-swimming young, to attach themselves to. For this purpose palisades of coarse wicker-work are placed in the path of currents which would otherwise sweep the young away. As soon as they have attained a length of an inch (which is in a little over a year, on an average) they are removed with hooks and placed on the bottom. Later, they are removed to above low-tide mark; again, higher up the beach, and again, still higher, there being four removals in all. In a year after the first removal they are ready for market. There are many of these Mussel-farms in France, the principal ones being at the Bays of Aiguillon and Chatellaillon, at Esuades, Charvon, Marsilly, at St. Valeny-sur-Somme, at Arcachon and other places. The most perfect system is attained at the latter place.

They are also cultivated in the Bay of Kiel, in North Germany, where small trees, fixed upright below low-water mark, have been recommended for catching the Spat.

In England, there is comparatively little done in Mussel-culture as yet. Attempts so far have had to struggle with the drawbacks of imperfect legislation. It is agreed that the culturist should have the same exclusive right to work his area and dispose of his product as has the farmer, and there should be as stringent laws to protect the one from trespass and theft as they are for the other. Such laws, however, until very lately at least, were wanting. It is estimated that an acre of Mussel-beds, properly cultivated, will yield one hundred and eight tons, worth at least fifty-four pounds per year.

The time will certainly come for Acadia when the Mussel-fishery will be a large industry. It is to be hoped that it will be wisely regulated during its life, and not left to be doctored when near its end.

) only way in which the Mussel seems to be of
to man, excepting the cases spoken of above, is when
rs on Oyster-beds. It grows faster, lives on coarser
ınd is altogether better fitted for the struggle for
ce than the Oyster. It also collects mud, and by all
e causes tend to crowd out the more valuable Mollusc.
re not heard that it is known to do any injury to our
beds in this way.

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### 15. **Modiola modiolus** (Lin.) Turton.

*Mytilus modiolus,* Lin.

**Horse-Mussel.**

*Modiola,* a little measure(?); *modiolus,* a little measure(?).

DISTRIBUTION. (*a*) *General;* — Low-water mark to one hundred fathoms. New Jersey to Arctic Ocean, and circumpolar. On European coast, southward to France; on Asiatic, to northern Japan; on western American, to California.

(*b*) *In Acadia;*—(in N. B.) Abundant on the southern coast everywhere from Grand Manan at least to St. John. Shediac, *Whiteaves.* (In N. S.) Annapolis Basin, somewhat abundant, *Verkrüzen.* All rocky shores, *Jones.* (In P.E.I.) Not reported but doubtless occurs. Probably to be found in rocky situations around the entire coast.

HABITS. This species more closely resembles *Mytilus edulis* than any other Mollusc. It is generally larger than the latter, growing to a length of six, and in extreme cases, mentioned by Willis, eight inches.

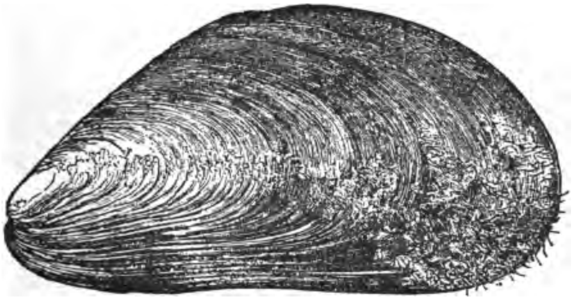

FIG. 12.—*Modiola modiolus.* Natural size.

It never has the blue black color of *M. edulis,* but instead has an epidermis of a dark chestnut or brown color. The umbo (or centre around which the lines of growth of the shell are arranged) is at the anterior or small extremity in *M. edulis,* but set a little back on the hinge margin in this species.

It does not, however, live in great beds above low-water mark as does *M. edulis.* It prefers gravelly and stony bottoms to which, half buried in the former, and half hidden in crevices in the latter, it attaches itself by its strong byssus, or "beard" of threads. Those torn from their hold in the tide-pools, bring away a large mass of gravel with them. Their mode of life may be well studied in the tide-pools about Passamaquoddy Bay, where they may be seen under the clear water with their posterior ends just above the bottom, gaping widely open. The shells bear many growths, both animal and vegetable, the most important of which are the great *Laminariæ*, or "Devil's Aprons," our largest sea-weeds. In storms these often drag their anchors, and the Mussels are thrown up with them on the beaches.

ECONOMICS. The Horse-Mussel is used for food in England, though to no great extent and only locally. Mr. Willis says in his time it was never exposed for sale in the markets of Halifax, and this seems to be true at present. The fishermen eat it very rarely, if at all, unless pressed by necessity. Some of them believe that the byssus or "beard," and probably the foot from which it springs, are poisonous. The writer has been told of two fishermen, who, storm-stayed at the Wolves, ran short of provisions. They ate Horse-Mussels and one of them died a few hours later. If his death really was caused by the Mussels, it is altogether probable that the byssus and foot really are the poisonous parts, and until we have further information on the subject, they had better be removed before the animal is eaten.

This species is also very good bait, and is said to be extensively used for that purpose in Newfoundland. But it is so much harder to obtain than *Mytilus edulis* (every specimen must be torn up by main force, unless carried up by *Laminariæ*) and so much less common and less accessible, that it is never likely to be of very much value.

The shells are usually very beautiful within, having often a delicate pearly lustre. They ought to be available for many ornamental objects, such as trays for trinkets, and the like. Occasionally pearls of poor lustre are found in them, but we have not heard of any of value.

In Europe it has been used to some extent to bind together the shifting materials of breakwaters on sea coasts. The tough threads of the byssus bind together everything within reach and a coating of these animals forms a strong and elastic buffer against the force of the waves.

### 16. **Modiola plicatula** Lamarck.

**Ribbed Mussel.**

[*Modiola*, a little measure (?); *plicatula*, somewhat folded].

DISTRIBUTION. (*a*) *General;*—Between tides and in very shallow water. Georgia to Casco Bay, Maine. Gulf of St. Lawrence.

(*b*) *In Acadia;*—Not formally reported from the New Brunswick coast, but doubtless occurs upon the North Shore. North Shore of Nova Scotia, *Jones* (on authority of (*Willis*). Prince Edward Island, *Dawson.* Probably occurs all around the southern part of the Gulf of St. Lawrence and in Bras d'Or Lakes, and possibly in some part of Chedabucto Bay.

HABITS. This species may easily be distinguished from the common or Horse-Mussel by the longitudinal foldings or ridges of its shell. These begin near the hinge and radiate to all the posterior part.

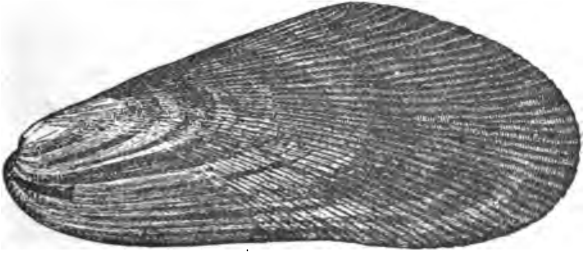

FIG. 13. *Modiola plicatula.* Natural Size.

It lives in brackish water, preferring ditches and sluggish marsh streams. It partly burrows into the mud, well up towards high-water mark, and attaches itself by a strong byssus, or mass of threads.

ECONOMICS. It is sometimes eaten, but is not considered as good as *Mytilus edulis.* It is a useful bait, but comparatively little used, chiefly, no doubt, on account of its scarcity. It does not appear to be used for either of these purposes in Acadia. In New Jersey and about Long Island it is employed as a fertilizer, and in all probability it occasionally forms a small part of the "Mussel-mud" of our North Shore.

17. **Margaritana arcuata** (Barnes) Stimpson.

> [The fresh-water Mussels of Acadia have not been well studied. Willis and Jones mention several species as occurring in Nova Scotia; Mr. G. F. Matthew knows of several in New Brunswick; and Dr. Dawson has reported two species from Prince Edward Island. It is uncertain how many of these may produce pearls, perhaps all of them under the requisite conditions. Mr. Matthew tells the writer that Mr. S. E. Gerow has identified *Margaritana arcuata* in the Society's collection, as *the* pearl-bearing species of our waters.]
>
> **Fresh-water Mussel, Fresh-water Clam, Pearl-Mussel.**
>
> *Mic-mac,* Sebooaas-uk.
>
> [*Margaritana*, a pearl; *arcuata*, arched].

DISTRIBUTION. *(a) General;*—Fresh-water streams of North-eastern America.

*(b) In Acadia;*—(in N. B.) Streams of southern counties, *S. E. Gerow.* (In N. S.) Rivers in Annapolis, Sackville River, *Willis.* All fresh-water streams, *Jones.* Not reported from Prince Edward Island.

HABITS. Our fresh-water Mussels are in general not unlike their salt-water namesakes in appearance and habits. The epidermis or outer skin varies from straw-color to olive-green, and is not attractive, but within the shells nearly always show the beautiful changing colors of mother-of-pearl.

They generally lie partly buried at the bottom of the pond or stream in which they live, with the posterior end protruding and gaping open. But by means of their powerful "foot," they can travel with some facility, and one often sees on sandy bottoms the long furrows left by them in their progress. The young are kept for a time in the gills of the parent. Our eastern species present little variety as to shape, size and color, but those of the west show the most remarkable diversity in these respects.

Pearls are, for the most part, found only in old or deformed shells. Mr. Gerow says that young or even middle-aged specimens very rarely or never contain them. They are believed to be formed only as the result of some disease, injury or irritation to the animal. Some naturalists have thought that the free perfect pearls are formed by the deposition of the pearly material around grains of sand or other accidental intrusions, for the sake of rendering the latter less irritating to the animal, and this is the generally received opinion. The proportion of individuals containing them is, however, very small; not one in a thousand contains a pearl of real value. The Mussels found in clear, running, gravelly streams are most likely to contain them.

ECONOMICS. Pearls are obtained from fresh-water Mussels in several parts of the world, notably China, Japan, Germany, and formerly, Scotland. They are also found in the United States, and some rivers have been systematically worked for them. Those of Scotland were formerly held in high esteem and have brought very high prices. A complete discussion of the subject may be found in the papers mentioned below.

In our own waters some very valuable pearls have been found in the fresh-water Mussel. Mr. S. E. Gerow, of the Customs, St. John, is the most expert and successful pearl-fisher of these provinces. The following facts have been given by him to Mr. S. W. Kain, and the latter has kindly allowed the writer to quote them.

"The largest pearl Mr. Gerow knows of that has yet been found in New Brunswick, weighed fifty-six grains, and was sold to parties in Philadelphia for four hundred and fifty dollars. . . . This was found in a brook near Sussex, Kings County. Mr. Gerow found one himself at Coldbrook, which weighed twenty-five grains, and he sold it for one hundred and fifty dollars. It was a very beautiful pearl of splendid lustre and perfect shape. He found another at the same place worth one hundred and fifty dollars, and weighing nineteen grains. Little New River, he says, is a good place for them. He found one there that weighed eighteen grains, and sold for one hundred and ten dollars. A man who was with him found one that he sold for thirty dollars. Mr. Gerow stated that he had seen a pearl from Nova Scotia that sold for seventy-five dollars. St. John, Kings and Charlotte are the only counties where he knows of much search having been made. Mr. Gerow found another weighing fifty grains, but it was not symmetrical. It was flat on one side, but of a very good purplish lustre. He sold it in New York for one hundred dollars, and another of similar shape in St. John for the same price." These, of course, are very exceptional instances, the great majority of those found being small, of poor shape and of bad color. It must be borne in mind, in considering these facts, that a great amount of persevering labor and considerable skill is required to obtain such results. Its returns are too uncertain to allow the fishery ever to be of much economic value.

### WORKS OF REFERENCE.

Pearls. By F. W. Rudler. Encyclopædia Britannica, 9th Ed., Vol. XVIII., pp. 446–448.

Pearls and Pearl-fisheries. By W. H. Dall. American Naturalist, Vol. XVII., 1883.

### 18. **Cardium Islandicum** Linnæus.

*Cardium ciliatum* Fabr.

**Cockle.**

[*Cardium*, heart-shaped; *Islandicum*, Icelandic].

DISTRIBUTION. (*a*) *General;*—Near low-water mark to fifty fathoms. Cape Cod to Greenland, and circumpolar. Northern Europe, Behring's Straits, Japan.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, twenty to forty fathoms, mud, *Stimpson.* Rather abundant in sheltered places, also found in Friar's Cove. (In N. S.) Annapolis Basin, rare, *Verkrüzen.* Halifax Harbor, *Willis* and *Jones.* Not reported from Prince Edward Island nor southern part of the Gulf. Probably occurs in mud and fine sand in many places in the Bay of Fundy and on the Atlantic coast of Nova Scotia.

HABITS. This is a very well-marked species, and, except in its young stages, cannot be confounded with any other on our coast. The valves are of a rounded form, and very convex or much hollowed out. On each, radiating fan-like from near the hinge, are about thirty-six raised angular ribs, which, on the free edge, give the shell a scalloped or crenulated appearance. The epidermis frequently rises into a bristly fringe on their summits, especially in young specimens, and this, with the fact that the summits are angular, will distinguish the young of this species from *Cardium pinnulatum* which has flattened ribs bearing scales, and no such epidermis. It is in our waters from two to two and one-half inches long and nearly as broad.

Of its habits, very little is known. It lives partly buried in mud or fine sand under a few fathoms of water. It must feed altogether upon microscopic organisms, plants and perhaps animals. It would probably have to be taken in a dredge of large mesh—so constructed as to allow the mud and gravel, etc., to pass through. It could probably be cultivated in our waters.

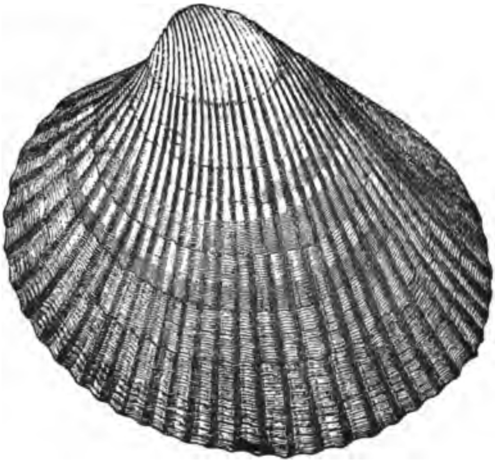

FIG. 14.—*Cardium Islandicum.* Natural Size.

ECONOMICS. This species is never, so far as we have been able to learn, been eaten in America. It is inserted in this paper on account of its close relationship to the edible Cockle (*Cardium edule*) of Europe ; without doubt it is edible, and is probably as good food as the European form, which it resembles closely in nearly all respects. The chief distinguishing mark between the two to the non-scientific observer is the smaller number of ribs, twenty-six, in *Cardium edule*, *C. Islandicum* having thirty-six.

The European Cockle lives on sand beaches and the banks of estuaries. We are told in the Fisheries Exhibition Literature that "It is equally good, raw or cooked, and may be eaten in almost any numbers with impunity. It may be boiled or roasted, eaten alone, or as a sauce to fish." It is gathered all the year round and sells for five pounds a ton. So important is the fishery in England, that two bays alone produce £35,000 worth of Cockles a year, Morecambe Bay alone producing £20,000 worth annually. In view of these facts it is well for us to keep in mind that we have a Cockle upon our own coast.*

The shells of our species are sometimes employed for making small articles of ornament.

19. **Venus mercenaria** Linnæus.

*Mercenaria violacea* Schum.

**Quahog or Quahaug, Hard Clam, Round Clam, Little-neck Clam.**

*Mic-mac,* Boogunumowas-uk. *Acadian French,* Pallude (?).

[*Venus*, Venus; *mercenaria*, used in trade].

DISTRIBUTION. (*a*) *General;*—In shallow water. Florida to Massachusetts Bay. Casco Bay and Gulf of St. Lawrence. Has been introduced into Europe.

(*b*) *In Acadia;*—(in N. B.) Caraquette, *Bell.* Bay Chaleur, Shediac, *Whiteaves.* (In N. S.) Halifax, Sable Island and Fishing Banks, *Gould* (on authority of *Willis*). St. Mary's Bay, "pretty abundant," *Verkrüzen.* Whole coast, common, *Jones.* Prince Edward Island, *Dawson.* It is evidently common in the Gulf of St. Lawrence, from Bay Chaleur to Cape Breton. It seems strange, however, that it should be reported as being common all around the coast of Nova Scotia, when it is totally unknown upon the Bay of Fundy coast of New Brunswick. It is probably to be found wherever the Oyster lives, and being somewhat more hardy, occurs rather beyond those limits.

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* As this paper is passing through the press, the following appears in a Boston newspaper, too late for its insertion in its proper place.

"NEW INDUSTRY.—Manchester-by-the-Sea, June 23. A new industry has recently started in Manchester. The scarcity of bait has led the fishermen to bait their trawls with Cockles and they prove much better than herring, as dogfish will not touch them, and, as they are tough, they will hold on the hooks much better. It is not uncommon to see from twenty to thirty men on the flats picking Cockles and from fifty to seventy-five buckets are secured at each tide."—*Boston Record, June 24th, 1889.*

Through the kindness of Mr. Andrew Lee, 2nd, of Manchester, the writer received specimens of these "Cockles," which proved to be not *Cardium*, but simply *Buccinum undatum* and *Lunatia heros.*

HABITS. This species is well-known to all oystermen and frequenters of fish-markets. It is a bivalve shell, having two very thick and heavy valves of a dingy white or ash color. Upon these are well marked, very regular, concentric folds, which become quite sharp where not worn by friction. Inside they are chalky white, except at the smaller end, where they are usually of a beautiful purple. The margin is finely crenulated around three-fourths of its circumference. The shell is roughly heart-shaped in outline, about three and one-half inches long when full grown, and two and three-quarter inches high. These characters will distinguish it from any other form found upon our coast. The purple color is wanting in young shells, quite variable in amount in others, and is often covered by a thick white glazing in very old ones, while in certain cases it is wanting altogether.

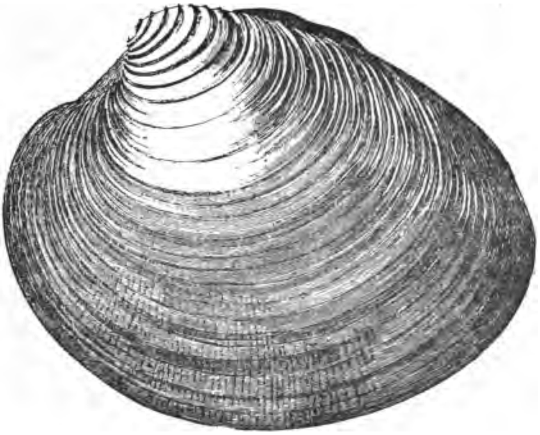

FIG. 15. — *Venus mercenaria.* Natural Size.

Of its mode of life, Prof. Verrill says,—" Common on sandy shores, living chiefly on the sandy and muddy flats, just beyond low-water mark, but is often found on the portion laid bare at low water of spring tides. It often inhabits the estuaries, where it most abounds. It burrows a short distance below the surface, but is often found crawling at the surface, with the shell partly exposed. It has short siphon tubes, united from the base to near the ends, and a large, muscular foot, with a broad thin edge, by means of which it can easily burrow beneath the sand when necessary." It clearly occupies much the same localities as the Oysters upon our North Shore, as it is along with them that it is usually taken. As it lives upon or very near the surface, it can be captured by raking or dredging, just as Oysters are; in the United States it is taken either by long-handled tongs or by the dredge.

ECONOMICS. In the United States this species ranks next to the Oyster as an article of food. Its annual value was estimated in 1883 to be $657,747, that of the Oyster being $13,439,000. These figures will show how valuable a Mollusc of our waters we are almost totally neglecting.

South of New York this is the common Clam of the markets. Between New York and Boston, this and the soft Clam, *Mya arenaria*, occur about equally in the markets, while north of Boston, the latter replaces the former. The best sell in New York for about three dollars per barrel, wholesale. Smaller ones are sold for sixty cents to one dollar per bushel. The smallest are used chiefly for pickling. They are taken from small boats by raking. It is also extensively used as bait. It sometimes contains pearls of white, blue, purple, violet or mixed colors, but they are rarely clear enough to be of any value.

This species has been introduced into several places in Europe, sometimes successfully, sometimes not. It has been acclimatized in the Dee, and, perhaps, also on the Cheshire coast, and at Bordeau, in France, but at least one attempt to make it live at Arcachon, in the south of France, has failed. These efforts to introduce it into Europe show how highly it is valued by people who have it not in their own waters, and they should have a lesson for us who value it little though abundant on our own shores.

In Acadian waters we cannot find that it is ever fished for separately. It is taken with Oysters and sold along with them. In St. John it is rarely or never sold separately, though in Halifax, where a few bushels a year are disposed of, it is sometimes sold by itself. Some persons consider it poor food, but its great use in the United States proves beyond question that it must be on the whole an exceedingly good food-mollusc.

This species has an interest for us also, from the fact that the purple part of its shell furnished the material for the purple wampum of the eastern Indians. White wampum, as has been mentioned (p. 12), was made chiefly from the columellæ or central columns of the two species of *Busycon* (also known as *Fulgur* and *Sycotypus,* and sometimes *Pyrula*). The purple was worth twice as much as the white, and both were made in the form of tube-shaped beads, perforated and polished; their value depended upon their polish and general perfection. It was a real currency among the Indians, true money, and, as one old writer says,—"their mammon." It was the chief medium of trade between the whites and Indians along the southern New England coast. The former, however, took to manufacturing it themselves, and this naturally led to depreciation of value and many abuses. Laws were passed regulating its use in trade, and it continued to be manufactured until within about fifty years, for use in the west. A very full and interesting discussion of this whole subject may be found in the first of the works mentioned below.

Among the Canadian Indians it was very extensively used. Early explorers (including Cartier) refer to it, and Kalm, the Swedish botanist and traveller, saw it in the middle of the last century among the Hurons and below Quebec. Charlevoix, in his letters (London, 1763), refers to "Wampum from the Venus shell," (p. 132) and gives a most interesting description of it. It was very highly valued by the Indians of Acadia, as Lescarbot tells us,* but was used by them for ornament rather than for money. It was also used by the Acadian Indians as well as by those of the south and west, as a sort of record of events, treaties, etc. Gesner tells that the Mic-macs had wampum records, and Charles Leland, in his "Algonquin Legends," mentions that the Passamaquoddys have wampum records at Pleasant Point, Maine, which can be read at present by only a single Indian. The only other evidence of its use in Acadia that the writer has been able to find, occurs in a paper by Professor L. W. Bailey, in No. VI. of this Society's Bulletin, entitled, "On the Relics of the Stone Age in New Brunswick." He mentions that some shell beads were found with the bones of a child upon the Tobique River. He says,—"They would appear to have been derived from the common fresh water Clams (*Unio* and *Anodonta*), and, considering the circumstances under which they were found, were probably of true Indian and domestic manufacture, rather than imported or imitative products, such as were abundantly made for purposes of barter, in more thickly settled localities."

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* See introductory part of this paper, p. 13.

The Molluscs, from the shells of which white wampum was chiefly made, are entirely wanting upon the shores of Acadia, though that from which the purple was made, viz.: the species we are now considering, was abundant; yet Lescarbot gives us to understand that neither kind was made in Acadia. He did not know, however, from what the purple wampum was made; he supposed it was from jet or a kind of wood. The Quahog must have been extensively used by them as food, and it seems strange that they should not have learned from the tribes to the south to make it themselves.

### WORKS OF REFERENCE.

Wampum and its History. By Ernest Ingersoll. American Naturalist, Vol. XVII., 1883, pp. 467-479.

Aboriginal Shell-money. By R. E. C. Stearns. Proc. Cal. Academy, Vol. V., pp. 113–120. Also American Naturalist, Vol. III., 1869, pp. 1–5.

Fishery for Quahogs. Fishery Industries of the U. S. Sec. V., Vol. II., pp. 595-613.

### 20. **Cyprina Islandica** (Lister) Lamarck.

**Black Quahog.**

[*Cyprina*, from Kupris, a name of Venus; *Islandica*, Icelandic].

DISTRIBUTION. (*a*) *General;*—Shallow water to ninety fathoms. Long Island to Arctic Ocean, and around the

North Atlantic to Northern Europe, Great Britain and Portugal.

(*b*) *In Acadia*;—(in N. B.) Grand Manan, rarely found, *Stimpson*. Bay of Fundy, six to ninety fathoms, *Verrill*. Passamaquoddy Bay, *Ganong*. Northumberland Straits, *Whiteaves*. (In N. S.) Halifax Harbor, common, *Jones*. Annapolis Basin, St. Mary's Bay, not abundant, *Verkrüzen*. (In P. E. I.) Not specially reported, but doubtless occurs. Probably to be found on mud and sand bottoms all around the coast.

HABITS. This is one of the two or three Molluscs popularly included under the name Quahog—*Venus mercenaria* being the true Quahog. In general appearance these two shells are much alike, their shape, especially, being very similar. But they may always be distinguished by their color, which, in the latter, is ashy or chalky-white, while in the former, if the epidermis is present (as it nearly always is) it is a dark burnt-brown, or nearly black color. This species wants the purple color of the interior of *V. mercenaria*, and differs from it also in

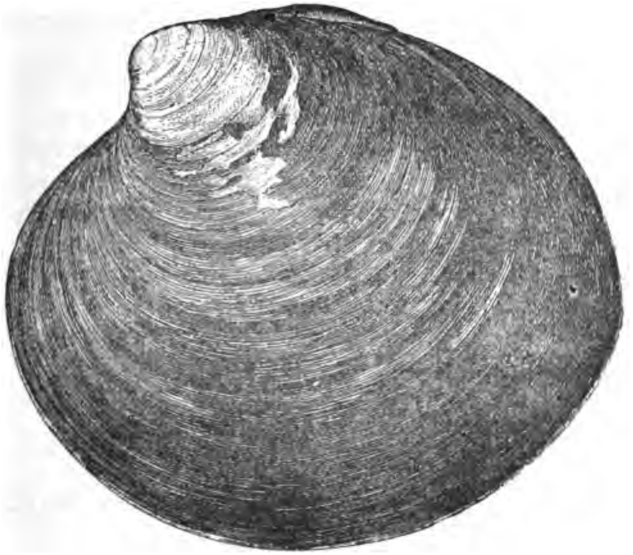

FIG. 16.—*Cyprina Islandica*. Natural Size.

being larger and more nearly circular in outline. The young have the epidermis lighter in color—a light, yellowish horn-color. It is three and one-half to four inches long and nearly as high.

It is never found living where it can be exposed even by the lowest tides, and hence, can be taken only by dredging or when cast up by the waves. It seems to prefer mud bottoms, and Gould says,—"is most frequent near where some river empties into the ocean." It does not live very deeply buried, as it is frequently cast up on beaches in great numbers by the waves after a storm.

ECONOMICS. A useful and good food-mollusc, and frequently eaten along with *Venus mercenaria,* from which it is not usually distinguished except by large dealers. It is said by good judges to be of very good flavor. Willis says it is considered excellent food in Nova Scotia. The writer has seen, at Lynn Beach, Massachusetts, dozens of men collecting this species which had been cast up in great numbers after a heavy storm. Many of them were shelled upon the spot, while the rest were carted away to Lynn. They seemed to be highly esteemed by those who were taking them. We do not know whether or not they are ever cast up in numbers upon our own shores, but they are taken not infrequently in dredging. They are neither abundant enough nor easily enough obtained to make it pay to take them for market. We cannot find that they are ever sold by themselves in our towns. They are a food of Cod and perhaps other fishes.

### 21. **Mactra solidissima** Chemnitz.

*Mactra gigantea* [of Willis].
*Spisula solidissima* Gray.

**Sea-clam, Giant-clam, Hen-clam, Beach-clam, Surf-clam.**

[*Mactra*, a kneading-trough; *solidissima*, very solid].

DISTRIBUTION. (*a*) *General;*—Low-water mark to ten fathoms. Florida and Gulf of Mexico to Labrador.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, *Stimpson.* Bay of Fundy, low-water mark to ten fathoms, *Verrill.* Passamaquoddy Bay, large and abundant, *Ganong.* Shediac, Point du Chene, *Whiteaves.* (In N. S.) St. Mary's Bay, very large, *Verkrüzen*. Mahone Bay, St. Margaret's Bay, Sable Island, *Willis*. Sandy beaches, whole coast, *Jones*. Prince Edward Island, *Dawson*. Probably occurs in sandy situations where there is clear water around the whole coast of the three provinces.

HABITS. When fully grown this is the largest shell upon our coast. From the common Clam it is distinguished by its greater size and proportionally greater weight, as well as by its shape. Unlike the latter, its sides slope directly away from the hinge so as to give it a rounded-triangular shape. When young it is covered with a dull-brown or straw-colored epidermis, which becomes mostly worn off in old specimens, and is entirely absent in those cast up by the waves. Large specimens are six inches in length, but J. Matthew Jones mentions a specimen from Sable Island seven and one-fourth inches long and six and one-half in breadth, and Willis gives them even a larger size.

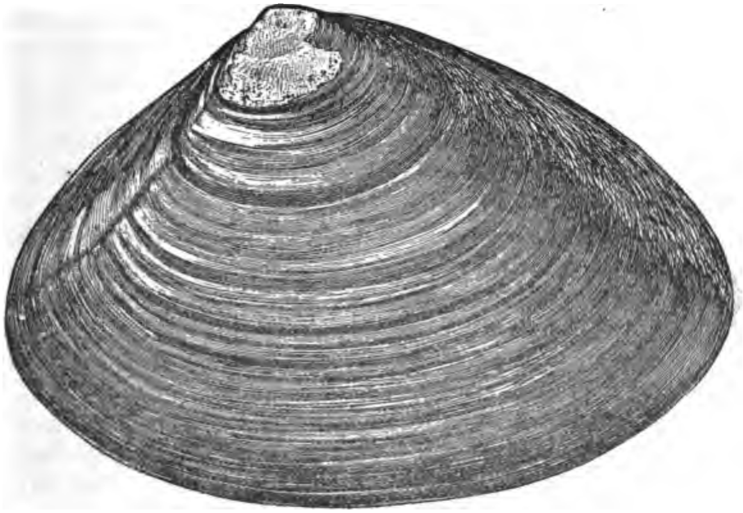

FIG. 17.—*Mactra solidissima*. Two-thirds of Natural Size.

It lives only in sand, and in situations where the water is clear. It burrows like the common Clam, but not deeply and does not form permanent burrows as does the latter. It is only uncovered at the lowest tides.

ECONOMICS. It is used for food and is also put up for bait. Gould says it "is much esteemed by some as an article of food, but it is apt to induce severe pain," while Ingersoll says it is by some considered unwholesome. Willis, however, states that it is considered a wholesome and nutritious article of food. Prof. Verrill writes that in large specimens the meat is usually tough, but the younger ones are quite as good as either the hard or soft Clam (*V. mercenaria* or *M. arenaria*). It is eaten by the fishermen of the Atlantic coast of the United States. They dig it with shovels at lowest tides, but those beyond reach of this method are taken by sharp sticks which are thrust between their valves by men wading. The latter keep pushing the stick into the sand and when it passes between the open valves of an animal they close upon it and the animal is easily drawn up. Its comparative scarcity and the difficulty of getting it prevent it from being of as much value as the other Clams, yet it has been estimated to be worth for bait in the United States, from $30,000 to $40,000 annually.*

The heavy shells are utilized for many purposes. The Indians used them as hoes for their corn in New England, and fishermens' wives use them for scoops, skimmers, etc. They are often used for painting on, and are not infrequently for sale in seaport towns decorated with marine views of varying degrees of excellence.

In our Provinces it is sometimes eaten by the fishermen, but we cannot find that it is ever exposed for sale in the markets, except rarely in Halifax. Verkrüzen states that it is eaten at St. Mary's Bay, Nova Scotia, and the fishermen on the Charlotte County coast occasionally eat it. It would be used more, no doubt, could it be more easily obtained.

22. **Mactra ovalis** Gould.

*Mactra ponderosa* Stimp.
*Mactra solidissima* [of Willis].†

[*Mactra*, a kneading-trough; *ovalis*, oval].

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*Another estimate gives its value as $7,500 annually.

†The writer has not seen Mr. Willis' annotated list of Nova Scotia Mollusca, but from the list of edible forms, copied by Knight, he appears to mean what we call *M. ovalis* when he mentions *M. solidissima*.

DISTRIBUTION. (*a*) *General;*—Low-water mark to ten fathoms or more. Cape Cod to Labrador.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, common in sand at low water, buried at a depth of four inches, *Stimpson, Verrill.* (In N. S.) Annapolis Basin, St. Mary's Bay, rare, *Verkrüzen.* Chester, Lunenburg, Mahone Bay, River John, *Willis.* Not reported from Prince Edward Island. Having been reported from so few places, it is impossible to state its distribution on our coasts.

HABITS. Similar to the last species, *M. solidissima,* in habits, and very like it in appearance. It is smaller, rarely exceeding four inches in length, but it is never distinguished from it by fishermen. The chief mark by which *M. solidissima* may be separated from it, is the presence of striations on the long hinge teeth, *M. ovalis* having none of these. It is much less common than *M. solidissima,* and is a more northern shell.

ECONOMICS. Probably it can be used for the same purposes as *M. solidissima,* though its smaller size and greater scarcity must render it less valuable. Mr. Willis says, referring to this species, that it "sometimes finds its way to Halifax market, and is readily disposed of."

### 23. **Mya arenaria** Linnæus.

**Clam, Soft Clam, Long Clam, Sand Clam.**

*Mic-mac,* Aas-uk. *Passamaquoddy,* Ess-sook (or Hess.) *Acadian French,* Cocque.

[*Mya,* perhaps *mus* of the ancients; *arenaria,* living in sand].

DISTRIBUTION. (*a*) *General;*—Between tide-marks to more than one hundred fathoms. South Carolina to the Arctic Ocean. Northern Europe and south to England and France. Northeastern coast of Asia to China and Japan. Sitka, Alaska.

(*b*) *In Acadia;*—(in N. B.) Abundant everywhere in sand and mud on the southern coast from Grand Manan to St. John and probably much further. Bay Chaleur, *Bell.* Shediac, *Whiteaves.* (In N. S.) Annapolis Basin and Bay of Fundy, common, *Verkrüzen.* Halifax Harbour, etc., very common, *Jones.* Prince Edward Island, common and large, *Dawson.* Abundant on every sand bar, *J. H. Duvar.* Undoubtedly one of the most common of Molluscs around the entire coast of Acadia.

HABITS. No reader of this paper can require a description of this species to enable him to identify the Clam. Who does not know this most ubiquitous of Molluscs? But not so many, perhaps, have acquaintance with its habits.

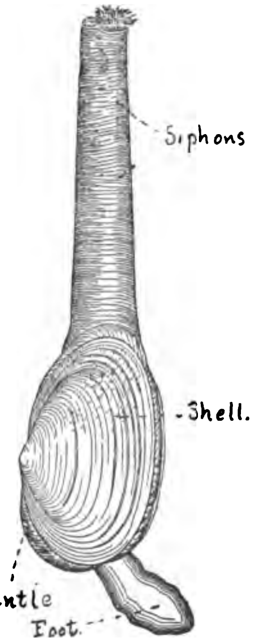

FIG. 18.—*Mya arenaria.* One-half natural Size.

Upon every mud or sand beach around the sea-coast of Acadia, the visitor will see very many round holes, half an inch in diameter, from which, as he walks near them, streams of water are frequently forcibly ejected. At the bottoms of these, at a depth of from six inches to over a foot, according to locality and character of the soil, the Clams are to be found, standing upright at the bottoms of their burrows, for such they are. Yet it does not properly stand upright in the sense that a man does, for it stands head downwards, the tough, black, protruding part, commonly called the head, not being that organ at all. If this black part be dissected, it will be found to consist of two tubes, the "siphons," bound together, with thick, tough walls, both leading into the general cavity of the animal in which all of the internal organs lie. The only other opening into the animal's body is a small one at the opposite end which allows the animal to thrust out its muscular, extensible "foot." It is by the use of this foot that it can move up and down in its burrow, within certain limits, or form a new one if necessary.

If a Clam be placed upright in some sand at the bottom of a glass vessel of salt water it will need only careful watching, with perhaps a little experimenting, to show that there is a current flowing into one of the tubes—that away from the hinge side and the larger—and a current out of the other, or the smaller one towards the hinge side. The dissection of another specimen will show the internal organs in position, and it may then be seen that the entering water must bathe the four great, flat gills as it passes downwards towards the mouth. These gills subserve the same function as do those of fishes, for in them the blood of the animal receives its needful oxygen and gives off its useless gases. Near the extreme anterior (though lower) end, guarded by four long ear-like flaps, is the minute mouth, and into it are guided by the flaps the minute animals, plants and crustacea upon which it feeds. The water, now robbed of its oxygen and food materials, passes along the back or hinge side, taking up useless matters given off by the animal and passes out through the other tube. These tubes have the power of great extension, so that when their owner is safe deep in its burrow, it can push them up to the surface and get clear, pure water At low water, when the flats are exposed, it retains water enough to last until the tide covers it again, when, doubtless hungry enough, it keeps up an active in and out circulation of water. If it is incautious enough to come to the surface, it is likely to be snapped up by some fish, for many of this tribe dearly love the Clam. It also lives under many fathoms of water, where its habits are probably the same. Its time of reproduction has not been studied carefully in our waters, but probably does not differ greatly from that of the same species farther south. Mr. Ryder (see paper referred to below) finds that they give out their eggs from the tenth of September to the middle of October. The young are without shells and can swim freely about for a time, a provision to allow them to be removed from the vicinity of their parents, and so to prevent overcrowding. They soon settle to a sand or mud bottom and as they develop the shell, burrow beneath the surface. They grow to a length of from one to two inches in seven months, these lengths being exclusive of the tubes. The artificial raising of the young is considered very difficult, though they may be transplanted readily to new beds.

ECONOMICS. This species has two very important uses—as human food and as bait in the fisheries. For the latter purpose it is very extensively used in Acadia, and also in the United States. Exact statistics of the quantity used for bait alone are wanting in the latter country, and the Dominion Fishery Returns probably give but an imperfect idea of the quantity used in the former. Nova Scotia is the only one of the Maritime Provinces which gives figures in the reports, which for the years from 1884 to 1887 are as follows:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1884 | 750 | barrels | @ | $7= | $5,250 | |
| 1885 | 1136 | " | | 5 | 5,680 | |
| 1886 | 970 | " | | 5 | 4,850 | + ($100 worth used as food.) |
| 1887 | 475 | " | | 7 | 3,325 | |

These are taken chiefly in Queens and Halifax Counties. No doubt the rapid diminution in quantity since 1885 is due to the greatly increased use of the Squid [which see] since that time. It is shelled and salted for long voyages, but carried alive to the fishing grounds when the latter are near home. Willis tells us that "It is said to be an irresistible bait to both haddock and codfish." Mr. J. H. Duvar states in his Report for 1880, and subsequently has informed the writer, that they were formerly much used in Prince Edward Island for mackerel bait and were gathered by the Acadian French who sold them to the fishermen for fourteen to fifteen cents per quart, shelled. Their use is now almost superseded by that of chopped herring. It is used in Gaspé and Quebec even more extensively than in Acadia.

As an article of human food, it is much more used in the United States than with us. North of Cape Cod it is the common Clam of the markets; south of New York it is replaced by the Quahog, *Venus mercenaria;* while between those places, both are found in about equal quantities. The very best come from Guilford, Conn., and sell for about three dollars per hundred. At this place a few of extraordinary size are found at lowest tides, the shells being six or eight inches long, and the animal of good flavor. These sell for about one dollar and twenty-five cents per dozen, the price for ordinary sizes being from ninety cents to two dollars per bushel, wholesale. The latter retail in the markets for from fifty to seventy-five cents per peck, according to size. In New Haven they are sold only in winter, and considered out of season in summer, though in New York they are sold throughout the year. A system of cultivation has been tried with good results. The total annual value to the United States of this species, including the large quantities collected for bait on the New England coast, is, according to the census of 1880, about $330,500. $562,376 according to another report. It has, however, been estimated by Mr. Earll, of the U. S. Fish Commission, in a speech made at the London Fisheries Exhibition of 1883, to be as high as $600,000 annually. These figures do not include those taken on the Pacific coast, to which it has been recently introduced and where it is spreading rapidly. It is sometimes taken by a system of ploughing, but rarely; the ordinary weapons for capturing it, are there, as with us, a simple bucket and shovel.

In England this species is used neither for bait nor for food, except very locally, being replaced entirely for both purposes by the edible Mussel, *Mytilus edulis.* This seems to us very remarkable and unaccountable, considering to what an extent other Mollusca are utilized there. It must be remembered that in England this is called the "Gaper," the name Clam being applied to a species of Scallop, *Pecten opercularis.*

In Acadia no statistics are available to show the annual value to the three Provinces of this species as food. The returns in the Annual Fishery Reports give the value of Clams as bait or else overlook them altogether. By the fishermen and the people of the sea-port towns it is quite extensively eaten in New Brunswick, and it is frequently for sale in the markets. In St. John, Mr. J. A. Turner estimates there are one thousand barrels per year sold, at an average price of one dollar and fifty cents per barrel, wholesale. The largest and best for city trade are brought from Lepreau.

In Nova Scotia it is very extensively used as food. Willis says it could be bought in the Halifax market for a shilling sterling per bushel in the shell, or for about threepence per quart shelled. At present, over three hundred barrels a year are sold, the most of which are brought from Cole Harbor and Chezzetcook. They sell for about ten cents a quart or six dollars per barrel shelled.

In Prince Edward Island it is very little used as food, being eaten only by the Acadian French, according to Mr. J. H. Duvar. It is not improbable that some very large individuals may be found in favorable situations, such as those referred to above, from Guilford, Conn. Certainly the sandy shores and warm summer temperature of the water ought to favor their growth to a large size.

In the vicinity of the St. Croix River, "Clam-bakes" are an institution of venerable antiquity. The Indians probably had them, and congenial spirits from the border towns still delight to return at times to the ways of their Clam-loving predecessors. On some favored spot on the shores of that splendid river they assemble by appointment; a great fire is built and by it many stones are heated and made very hot. The embers are then raked aside and upon the stones is placed a layer of wet sea-weed, on which a layer of Clams is laid. Then comes another layer of sea-weed and another of Clams, and so on, the top of the whole being a cushion of sea-weed of extra thickness. Over the whole mass is perhaps a piece of canvas thrown, and in such an oven are the Clams slowly steamed to the proper degree of deliciousness. A constant concomitant and the most pleasing feature of these banquets is the invariable good-nature and good-fellowship which prevails.

The great heaps of shells on the Charlotte County coast, made as we know by the Indians, show of how much importance this species was to them. It doubtless formed the bulk of their food during the summer, when large game was out of condition, and possibly, as Mr. Matthew has shown, to some extent in winter also. The heaps are sometimes two or more feet deep, and cover several acres. It was probably used quite extensively by them in Nova Scotia and Prince Edward Island also, but as yet the shell-heaps of those Provinces have received but little attention and we hardly know anything of their number, extent or contents.

Clams as well as Oysters are sometimes found, in which a considerable portion of the edible part is of a green or bluish-green color. This has been repeatedly shown by chemists to be non-metallic and perfectly harmless, though some think they have a coppery taste. The color is due to the nature of the food, being produced when they feed upon certain diatoms or minute plants (chiefly *Navicula ostrearia*, var. *fusiformis*). Experiments show that the green color can be artificially produced by feeding them upon these diatoms, and that it will disappear in a few days when they are changed to other diet. The green Clams may be eaten with perfect confidence.

WORKS OF REFERENCE.

The Oyster, Clam, and other Common Mollusks. By Alpheus Hyatt. Boston, 1884, 12mo., 65 pp., many figures.

On the Rate of Growth of the Common Clam, etc. By John A. Ryder. Bulletin U. S. Fish Commission, Vol. V., 1885, pp. 174–176.

On the Green Coloration of the Gills and Palps of the Clam (*Mya arenaria*). By John A. Ryder. Bull. U. S. Fish Commission, Vol. V., 1885, pp. 181–185.

The Clam Fisheries. Fishery Industries of the U. S., Sect. V., Vol. II., pp. 581-594.

### 24. **Mya truncata** Linnæus.

[*Mya*, perhaps the ancient *mus*; *truncata*, cut short.]

**British Gaper.**

DISTRIBUTION. (*a*) *General;*—Low-water mark to below one hundred fathoms. Cape Cod to Greenland. North European seas to Great Britain.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, low-water mark, *Stimpson*. Shediac, *Whiteaves*. Not abundant on the southern coast. (In N. S.) Halifax Harbor, not uncommon, *Jones*. Not reported from Prince Edward Island. Probably not abundant on our coast.

HABITS. This species may be distinguished from the common Clam (*Mya arenaria*), by the shape of the valves, for in it the posterior end, or end from which the tubes protude, is cut sharply off, as its name signifies, and is not evenly rounded as in *Mya arenaria*. The posterior end also, even when the shell is closed, gapes widely open, instead of only slightly as an *Mya arenaria;* whence comes the name, given above, by which it is known in England. The epidermis is prolonged into a tube posteriorly helping to give the protection which is lost by the truncation of the shell. It is from two to three inches in length. In its habits it is not known to differ essentially from *Mya arenaria*,

ECONOMICS. It is probable that this species is often dug with and used for the same purposes as *Mya arenaria*. Indeed, as both are variable in form they frequently are much alike, and it is not probable that they are ever separated by the fishermen. They are both useful for the same purposes — bait and food. Forbes and Hanley tell us that it is eaten both in Britain and North America. It is more common in England than *Mya arenaria,* but the reverse is certainly the case with us. It is an important article of food to the Cod, being found in their stomachs in great numbers, especially on the Newfoundland Banks.

25. **Solen ensis** Linnæus.

Var. **Americana** Gould.
*Ensatella Americana* Verrill.

**Razor-shell, Razor-fish, Long Clam, Knife-handle.**

*Mic-mac,* Sasabegwit, pl. Sasabegwidul.

[*Solen*, the ancient name ; *ensis*, a kind of sword, a scimitar.]

DISTRIBUTION. (*a*) *General;*—Low-water mark to twenty fathoms. Florida to Labrador.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, at low water, in sand, rare, *Stimpson.* Eastport, *Gould.* Bay of Fundy, *Verrill.* Passamaquoddy Bay, *Ganong.* Shediac, *Whiteaves.* (In N. S.) Sandy shores, whole coast, *Jones.* St. Mary's Bay, *Verkrüzen.* (In P. E. I.) Common in Northumberland Straits, *Dawson.* Probably to be found everywhere on the shores of Acadia where there is sand and clear water, though nowhere very abundant.

HABITS. We have upon our shores no Mollusc so strikingly distinct from all others as this. Its parallel slightly curving sides and squarely truncated ends are found in no other of our shells, and they give it a shape which fully justifies the names of "Razor-shell" and "Knife-handle," by which it is commonly known. It grows to a length of about six inches, though eight inches is not unknown. The young animal is covered with a shining greenish-yellow epidermis, which partly disappears in old shells, leaving the latter a dull chalky white. At one end (the posterior) project slightly two short fringed tubes — united below their tips. At the other (anterior) end projects the powerful "foot" by which the animal is enabled to burrow so rapidly in the sand. These burrows are found only near extreme low-water mark. They are two to three feet deep, and so rapidly can the animals travel down them that a man cannot dig quickly enough in the sand to catch them. Frequently at low water they may be found at the surface, with about an inch of the shell projecting, but if not approached quietly and seized quickly they are soon out of reach. A method of catching Razor-shells, frequently practiced in England, is to drop a little salt in the burrow, adding a little water to carry it down. This is literally putting salt on their tails, for they stand head downwards in their burrows. The irritated animal always comes to the surface and can be seized by the hand. Another method is to push down the burrow a stout wire, having at its end a barb or hook; this pierces the animal and it can be easily drawn up. Both of these methods would certainly work with our species.

These animals, like most others which cannot move about, feed on microscopic plants and animals, which are drawn into their bodies with water by one of the fringed tubes, the other being for the removal of waste matters. They are rather fastidious in their habitat, requiring clean sand and clear water. They are, hence, not found on rocky shores nor in estuaries. They are eaten by some fishes, principally by the Skates.

ECONOMICS. Of Razor-fishes in general, Forbes and Hanley tell us,—"They are among the most delicious of shell-fish when properly cooked — broiling is the best method." Willis says our species is an excellent article of food, and they have been sold in the Halifax market for one penny each. Mr. J. H. Duvar remarks that when offered for sale at rare intervals in Halifax, they have found purchasers among epicures. It seems to be entirely unknown as an article of

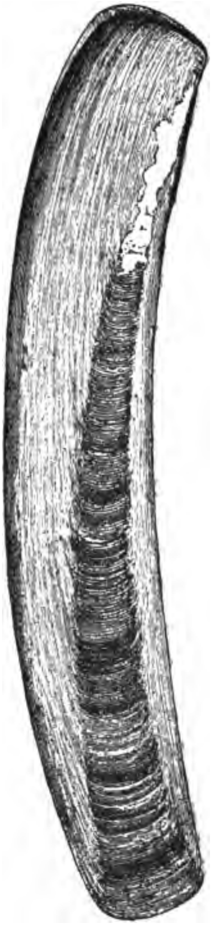

FIG. 19.—*Solen ensis*, var. *Americana*.
Natural Size.

food in St. John or Prince Edward Island. The fishermen of the Charlotte County coast, and of parts of Nova Scotia, know and esteem them, and the same may be true of the fishermen of other parts of Acadia. The shells are used for some ornamental purposes.

All testimony goes to show that it is an excellent food Mollusc, but its comparative scarcity and the difficulty of obtaining it will prevent its extensive use.

### WORK OF REFERENCE.

Fishery Industries of the U. S. Sect. V., Vol. II., pp. 613–615.

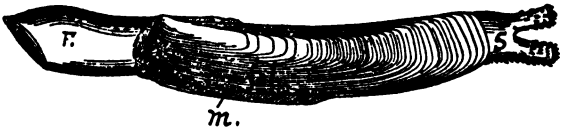

FIG. 20.—*Solen ensis*, var. *Americana*, Half Natural Size. *S.*, Siphons; *Sh.*, Shell; *M.*, Mantle; *F.*, Foot.

## 26. **Zirphæa crispata** (Linn.) Mörch.

[*Zirphœa*,—(?); *crispata*, wrinkled.]

**Date-fish.**

DISTRIBUTION. *(a) General;*—Shallow water to seventy fathoms. Connecticut to Gulf of St. Lawrence. Iceland. Northern Europe to Great Britain and France. West coast of America, south to California.

(*b*) *In Acadia;*—(in N. B.) Grand Manan, very rare, *Stimpson*. Bay of Fundy, eight to seventy fathoms, in hard clay, *Verrill*. L'Etang Harbor. (In N. S.) Sable Island, large specimens, *Jones* (on authority of *Willis*). Prince Edward Island, boring in red sandstone reefs, *Dawson*. Probably to be found in suitable localities all around our coast.

HABITS. This is a well-marked shell and not like any other yet found on our coast. It is a bivalve, each valve of which is somewhat like that of the Clam. Across the middle runs a furrow, in front of which the lines of growth rise in regular teeth, which are entirely wanting behind that line. The shell gapes very widely open both before and behind, and the dorsal margin in front of the furrow is folded over outwards It does not exceed four inches in length in our waters, but grows much larger to the south and on the west coast. It is a burrowing Mollusc, and lives in hard clay, soft stone or even submerged wood.

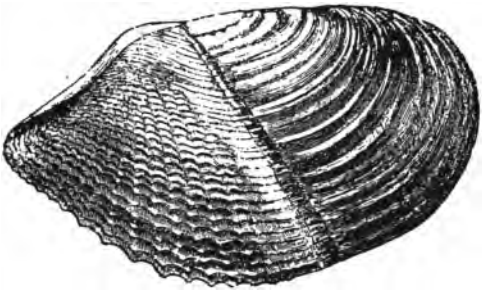

FIG. 21.—*Zirphæa crispata.* Natural Size.

ECONOMICS. On the coast of California this species is extensively eaten. It is, however, much larger than with us, and is regularly exposed in the markets under the name of "Date-fish." It is not abundant enough in Acadia to be of any value. It appears to do no injury in its burrowing, to any of man's works.

### 27. **Teredo navalis** Linnæus.

[*Teredo*, a borer; *navalis*, infesting ships.]

**Ship-worm.**

DISTRIBUTION. (*a*) *General;*—In submerged timber. Gulf of Mexico to Vineyard Sound. Gulf of St. Lawrence, abundant. [Massachusetts Bay to Chedabucto Bay, much less abundant]. Sweden and Great Britain to Sicily; Algeria and the Black Sea.

(*b*) *In Acadia;*—St. John, Shediac, Pictou, *Whiteaves.* Northumberland Straits, St. George's Bay, Strait of Canso, Chedabucto Bay and all around Cape Breton, abundant and very destructive. Also around entire coast of Nova Scotia, but much less abundant and not troublesome, *Martin Murphy*.

[As the species of *Teredo* inhabiting our waters have not been well worked out, it is quite probable that there exists at the localities named above other species in addition to *T. navalis*. Indeed, Mr. Murphy, in the second of the papers quoted below, expressly states that *either T. navalis or T. Norvagica* exist all around the coast of Nova Scotia. It is greatly to be desired that a thorough study of our species should be made, and all are earnestly requested to assist in this work. Specimens from our waters, either of the animals preserved in alcohol, or of the wood containing their burrows and shells, would be of great value. They should be sent either to Mr. J. F. Whiteaves, of the Dominion Geological Survey, or to the writer.

*Teredo navalis* prefers water warmer than that of the Bay of Fundy and the Atlantic coast; and hence we find it, though present, not at all troublesome in these waters. Its range, where destructive, on the other hand, is nearly coincident with that of the southern fauna of the Gulf of St. Lawrence. Mr. Murphy, in his admirable paper on the *Teredo* in Nova Scotia, cited below, misses the explanation of this fact. It is not because these waters are ice-bound in winter that it exists there, but because their warmer summer temperature affords more favorable conditions for the development of its young.]

HABITS. It is difficult to distinguish between the different species of *Teredo*, of which more than twenty are known, but the group or genus, as a whole, is easily recognizable. While differing somewhat in detail, their habits and structure are in general similar, and a description of one will answer with but few modifications for all.

*Teredo navalis* is the best known of all of the species on account of its great damage to fixed and floating timber works in Europe, particularly the dykes and docks of Holland. It is by no means certain that it is the most common species in Acadia, but beyond all question it does occur on the Gulf of St. Lawrence coast.

In external appearance, the animal fully justifies its common name. But it is a true Mollusc, and a bivalve like the Clam. Though elongated and cylindrical, it shows no trace of constrictions. The anterior end, that buried deepest in the wood, is the largest, and at its extremity bears the two valves, greatly reduced and forming the boring apparatus. Between them occurs the opening through which the slender "foot" can be prötuded, an organ corresponding with the "foot" in the Clam. Except for this opening the mantle or "skin" of the animal is unbroken until the posterior end is reached, where the body terminates in two tubes or siphons, corresponding with those in the Clam. Probably one of these is for the admission of food and fresh water, and the other for the excretion of waste water and the wood which passes through the animal's body. These siphons can be retracted and the burrow quite closed by two little calcareous valves or pallets, borne near the siphons. The latter, when the animal is distended, are at or near the surface of the wood.

In burrowing, the *Teredo* generally follows the grain of the wood, but will cross it when necessary to avoid a knot, nail, neighbour's tube, or other obstruction. They never pierce each other's tubes. As the latter are formed, they are lined by a calcareous layer, more or less thick, and firm enough to allow large pieces of it to be removed entire from the wood after the animal is dead. It is still doubtful what mechanism the animal employs in burrowing. Many naturalists think the valves, armed by numerous fine constantly growing teeth, form the apparatus, and that by them the animal eats, or rather files, its way onward. One observer states, that by breaking away the side of a burrow, he has actually seen this operation going on; others claim that the foot accomplishes the work, by the same unknown means by which certain limpets can excavate rocks. It is pretty generally agreed, however, that the *Teredos* do not get nourishment from the wood, but bore it simply to form a home. Their food consists of minute animals and plants, taken into the body through one of the siphons.

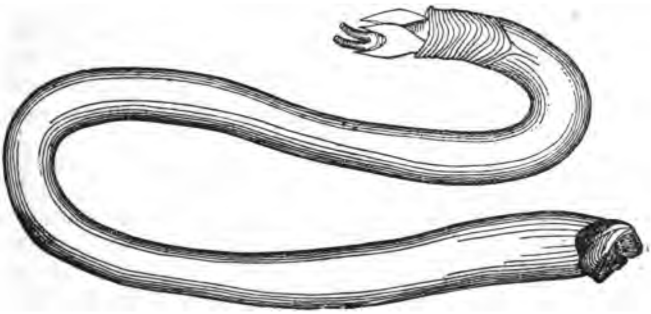

FIG. 22.— *Teredo navalis.* Twice Natural Size.

The time of breeding of this species differs somewhat with the locality, but it takes place generally in the spring or summer months. They are very prolific. The young at first can swim freely about, but in a very short time (one writer says four days) they are fully equipped for their life work, and attaching themselves to wood, begin to bore their tunnels. After entering the wood, they increase rapidly in size, so that the adult burrows are many times larger than those by which the young enter. It is thought that as a rule they do not live longer than a year or eighteen months. They require pure salt water, free from sediment, and cannot generally live in brackish or polluted situations. Their tubes are sometimes ten inches long, but generally not more than half that length.

A piece of Teredo-bored wood shows but little outward trace of the condition within. Except for the small holes made by the entering young, it may appear quite sound, when in reality riddled by the burrows and composed of almost nothing but their calcareous tubes.

Along with the *Teredo*, there is frequently found a small crustacean, *Limnoria lignorum*, which also forms burrows and is very destructive. They work, however, in different ways, for the latter attack only the surface of the wood, and honey-combing it so thoroughly that nothing is left but partitions between burrows, allow it to be easily destroyed by the waves. As the outside is removed, they progress deeper, and so rapidly do they work that an inch a year is frequently removed all around the largest submerged timbers. The minute size of the burrows, about one-sixteenth of an inch in diameter, and the absence of a calcareous lining, as well as the presence of the crustacean itself, will always distinguish its ravages from those of the *Teredo*. It largely replaces the latter on those parts of the shores of Acadia where the *Teredo* does little harm, *i. e.*, on the Atlantic Coast of Nova Scotia and around the Bay of Fundy, and it does great damage in these localities. It is particularly destructive at Digby. The *Teredo*, on the other hand, perforates the wood through and through, and makes it so fragile that it will break under a slight shock. It seems to have little preference in regard to the wood it attacks, the hardest and softest being equally injured. The southern palmetto is said to withstand it.

ECONOMICS. About the years 1730–32, great damage was done to the dykes of Holland by this *Teredo*. A general submergance of the country was threatened, and the consequent alarm led to the careful study of the habits and structure of the animal. Since then, it has appeared in numbers at different periods. In 1858 fresh alarm was caused, which resulted in the appointment of a commission to investigate the whole subject and experiment upon different methods for withstanding its ravages. An account of the work of the commission, by one of its members, is given in the first of the papers whose titles are below.

The animals work with extreme rapidity. In San Francisco Bay, they have destroyed great timbers within eighteen months, and even in certain cases within six months. It is recorded also that in Chesapeake Bay they have perforated small timbers completely in six weeks. Ships have been riddled on their first voyages. It is impossible to calculate the enormous damage annually done by this and allied species to naval works in different parts of the world.

In our own waters much damage has been done at Pictou and other places on the North Shore; piles of wharves and bottoms of ships alike suffer. Mr. Murphy, in his admirable paper quoted below, says that at Sidney Harbor, Cape Breton, "the Teredo is seemingly as destructive, if not more so, than at any point on our coast." Mr. Whiteaves, in one of his reports, tells us that "Ship-worms of large size are said to be found at Halifax."

On the southern coast, their work is likely to be confounded with that of *Limnoria lignorum*, referred to above. It was probably the work of both together that completely destroyed within a period of six years a large and strong tide-dam at Frye's Island, Charlotte County, but it is the *Limnoria*, as Prof. Verrill points out, that does the damage to weir-posts in that region. In St. John harbor they do no damage. Mr. S. W. Kain tells the writer that piers do not need protection from *Teredo*, though *Limnoria* is somewhat injurious. Pieces of timber which have been under water for many years show no trace of the presence of the former, and ships which enter the harbor infested by them, are free from them within two days. It is generally believed that this is caused by the great amount of fresh water in the harbor. Mr. Kain says: "There seems to be a consensus of opinion among all shipping men that the *Teredo* is not found in the Harbor of St. John, nor in any harbor where there is any considerable body of fresh water." The cause assigned no doubt explains the killing of those which are brought into and their absence from the

Harbor, but does not account for their absence from the remainder of the Bay where clear salt water is found. No doubt the low temperature of the water in the summer months, making the conditions for their young so unfavorable, is to be thanked for our comparative immunity from them.

Such being the relation of *Teredo* to man's interests, it is not surprising that great attention and much experiment have been given by practical as well as scientific men to methods of circumventing them. The most carefully conducted and systematic experiments on record are those described by Dr. Von Baumhauer in the first of the works mentioned below. It obviously does not come within the scope, as it certainly is not allowed by the limits of a paper of this character, to describe at length the experiments or the mode of application of the latter. Those practically interested are referred to the three papers below, that by Dr. Von Baumhauer, the very excellent one by Mr. Murphy, and that by J. W. Putnam, which, though it contains some errors of natural history, appears to be sound and complete from a practical standpoint. All of these are easily accessible.

The Commission, of which Dr. Von Baumhauer was a member, experimented with all means proposed to them by inventors and others. Eight different methods of coating wood were tried, including mineral paints, varnishes, poisonous substances, etc., but none of them proved of any value. They tried six methods of impregnating wood with different substances, including some of the very poisonous salts of copper, iron and lead, only one of which proved efficient. The successful one was oil of creosote — a coal-tar product.

This method proved successful when good oil was used, and to-day it is acknowledged by engineers that the only efficacious way to preserve timber permanently from the attacks of the *Teredo* is to thoroughly impregnate it with creosote. The process must be thorough, for partially filled timbers will be destroyed. The mechanics of the process of impregnation are described in the paper by J. W. Putnam, referred to below. It consists in forcing the oil under great pressure into the previously prepared wood. Woods of loose texture are the best, for they take the oil better. Creosote has the advantage also of preserving timbers not only from *Teredo*, but from other destructive agencies, for it is a good antiseptic.

This method has been tried and found good in our own waters, as the following passage from Mr. Murphy's paper proves. Speaking of Sidney harbor, Cape Breton, he says: "Here the *Teredo* is seemingly as destructive, if not more so, than at any point on our coast, and here, about ten years ago, a coal-loading pier was erected, sufficiently large that three ocean-going steamers could load coal at the same time. The pier runs out into the harbor. It was erected entirely of pine trunks, creosoted in Great Britain, and sent out here. It has most effectively withstood the ravages of the *Teredo*, whilst all other piles in the neighborhood had to be renewed twice." Mr. Murphy points out the desirability of the establishment of a creosoting apparatus in Nova Scotia, and of a careful study of means of overcoming the *Limnoria lignorum*.

There are other methods of protecting marine works from *Teredo* which have their value. A timber completely sheathed with metal is safe; hence copper-bottomed ships are not troubled. Docks and wharves have been sheathed with different metals, but these are efficacious only so long as the surface is unbroken. Accident, the action of the water on the plates, etc., will not, however, as a rule, long permit this. A modification of this method consists in covering the timber with short iron nails having square, flat heads. But these must be placed close together, with their edges touching, and this is very expensive. In the American Naturalist, Vol. XVI. 1882, p. 967, another method is described as follows: "His machinery cuts out a cylinder two inches thick from between the core and the outside of a log, and of any desired caliber. By retaining the core and filling the cylindrical excavation around it with a special cement, it is thought that the ravages of the *Teredo* could be confined to the outer part of a pile so treated, and the core, which is expected to sustain the needed weight, would be protected by the cement, which in its turn would be preserved from friction by the outer coating of wood and bark." The writer's friend, Mr. K. Miyabe, of Japan, tells him that a countryman of his has invented a method of preventing its ravages. It consists in a process of lacquering. Coatings of barnacles, when numerous and near enough together so that their bases touch, form a protection, but one which it would be difficult to produce artificially. Coatings of the common Mussel (*Mytilus edulis*) have been suggested also; but much the same objection would apply to them, and the coating would be liable to be removed by accident. An annelid preys upon the *Teredo*, but not to an extent sufficient to assist man. Fresh water is one of their greatest enemies, and foul water another. A method of ridding a ship of them which has been suggested is to take her for some time into fresh water; but our ship owners would not be long in seeing objections to this. There seems to be a possibility, however, that under certain circumstances wharves might be protected by being built where fresh water streams empty, or even, in some cases, where foul water, such as comes from chemical works and the like, could be directed against them. The latter remedy, however, would be too likely to become worse than the trouble.

As an offset to all the damage done by the Ship-worms only a single benefit to man has been suggested. They certainly help to remove old wrecks, both floating and sunken, which would be a constant peril to navigation.

WORKS OF REFERENCE.

The Teredo and its Depredations. By Dr. E. H. Von Baumhauer [translated from Archives of Holland, Vol. I.]. Popular Science Monthly, Vol. XIII., 1878, pp. 400–410, 545-558. Its more important parts are quoted in the following.

On the Ravages of the Teredo Navalis, and Limnoria Lignorum, on Piles and Submerged Timber in Nova Scotia, and the Means being Adopted in other Countries to Prevent their Attacks. By Martin Murphy. Proc. and Trans. Nova Scotian Inst. Nat. Sci., Vol. V., Part IV., 1882, pp. 357–376.

The Preservation of Timber. By J. W. Putnam. Scientific American Supplement, Vol. X., No. 236, July 10th, 1880, 3762–3763.

Teredo. By J. T. Cunningham. Encyclopædia Britannica, 9th Ed., Vol. XXIII., 1888, pp. 184–186.

The Teredo or Ship-worm. By R. E. C. Stearns. American Naturalist, Vol. XX., 1886, pp. 131–136.

### 28. **Teredo Norvagica** Spengler.

[*Teredo*, a borer; *Norvagica*, inhabiting Norway.]

**Ship-Worm.**

DISTRIBUTION. (*a*) *General;* — Cape Cod northward North European Seas.

(*b*) *In Acadia;* — "Marine slip timbers at Pictou. (Whiteaves)," *Jones*. Further distribution not known. As stated under *T. navalis*, much or most of the damage attributed to that species may be due to this.

HABITS. In general similar to *Teredo navalis*. It would be extremely difficult for the untrained observer to distinguish them. Specimens should be sent to some special student of Mollusca.

ECONOMICS. Similar to *T. navalis.*

### 29. **Teredo dilatata** Stimpson.

[*Teredo*, a borer; *dilatata*, swollen.]

DISTRIBUTION. (*a*) *General;*—South Carolina to Cape Ann. Sable Island.

(*b*) *In Acadia;*—" Very large specimens have been received from Sable Island, taken from wrecked timbers (Willis)," *Jones.*

[There is a possibility that this species may be the following, but it is unlikely. It is a southern species, but many such occur on Sable Island.]

HABITS. In general similar to *Xylophaga dorsalis*. They probably cannot be distinguished by the untrained observer. This is a small species, and is nearly as broad as long. It is about half an inch in diameter.

ECONOMICS. Probably similar to *Xylophaga dorsalis.*

### 30. **Xylophaga dorsalis** (Turton) Forbes and Hanley.

[*Xylophaga*, wood-eating ; *dorsalis*, from plates on its back.]

[The *Teredo dilatata* of Mr. Whiteaves' first report, as he tells us in his second.]

DISTRIBUTION. (*a*) *General;* — Northern Atlantic ocean.
(*b*) *In Acadia;* — New Brunswick and Nova Scotia waters.
Mr. Whiteaves says in his first Report, — "Principal Dawson informs me that great damages have already been done to the woodwork of wharves and harbors in Nova Scotia and New Brunswick, by this species of *Teredo.*

HABITS. Though in general structure, habits, etc., it is probably quite like *Teredo navalis,* it differs much in appearance. It is from one inch to one and a half inches long and has the organs more concentrated than in *Teredo,* forming a spherical mass from which a slender tube projects backward bearing the siphons. We find it showing characters intermediate between the *Teredos* and the genus *Pholas*; the latter are shelled bivalves which bore into stone. This species would hardly be distinguished by the beginner from the last.

ECONOMICS. On account of its smaller size, and consequently short burrows, it is not so destructive as the larger Teredos, but it nevertheless does much damage both to floating and fixed timber works in Europe.

Mr. Whiteaves says in his first Report, — "Mr. Nelson Davis, of Montreal, tells me that the brigantine 'Magdala,' which was built at St. John, N. B., was completely riddled by this ship-worm some time ago, on her first voyage from St. John to Liverpool. . . . . . The whole of the ship's bottom had to be renewed and covered with copper sheeting before she was again seaworthy."

# APPENDIX.

## THE REPORT OF THE COUNCIL.

The Council beg leave to submit the following summary of the work for the year.

There have been added to the membership seven ordinary, four corresponding and five associate members.

Nine regular meetings were held, at which the following papers were read:

1888.

| | | |
|---|---|---|
| Feb. | 7. | Echinodermata of New Brunswick, by W. F. Ganong, M.A. |
| Mar. | 6. | The molluscs of the oyster beds of New Brunswick, by Rev. H. W. Winkley. |
| Mar. | 6. | Does our indigenous flora give evidence of a recent change of climate, by Jas. Vroom. |
| April | 3. | The habits of Birds, by M. Chamberlain. |
| May | 1. | History of fossil plants, by Geo. F. Matthew, M. A. |
| May | 16. | Weeds, by Geo. U. Hay, Ph. B. |
| Oct. | 2. | Meteorological instruments and their uses, by W. F. Best. |
| Nov. | 6. | Earliest denizens of the land and air, by G. F. Matthew, M. A. |
| Dec. | 4. | Zoological Notes, by W. F. Ganong, M. A. |
| Jan. | 6. | Some characteristics of Molluscs, by Geo. F. Matthew, M.A. |

The librarian in handing in her report of the library makes special mention of an archæological map of Abury, and a book on the British and Roman Antiquities, of Wiltshire, England, presented by the Right Rev. Bishop Kingdon, and to the publications of the United States Geological Survey. Back numbers of the American Journal of Science and of the Geological Magazine have been purchased, and for the benefit of those interested in Geology and Botany, current numbers of the American Geologist and Botanical Gazette are received by subscription. The books received for the past three years have been numbered, catalogued and arranged. It is the desire of the Council to obtain the scientific works of Sir J.

W. Dawson, and any contributions to that end will be thankfully received.

The curators have much pleasure in reporting valuable additions to the museum, as shown by the appended list of donations, and recommend that the collections be open for public inspection on every Tuesday evening and Saturday afternoon.

The elementary lectures on Chemistry, Geology, Zoology and Botany, referred to in the last Bulletin, were most successfully continued during the present year.

The Society took advantage of the presence in the city of Sir J.W. Dawson to tender him a reception. It was considered fitting that some recognition of his visit should be made, as it was at his suggestion that the Society was formed; and also to offer a tribute of respect to one who has attained so eminent a position in the scientific world. Arrangements were according made, and on July 19th the reception was held. The Lieutenant-Governor, Sir Leonard Tilley, patron of the Society, presided, and in a short address introduced the guest of the evening, who, in reply, spoke at considerable length, reviewing the work done by the Society, as well as of its present efforts, its aims and needs. The rooms were crowded with visitors who were introduced to Sir William by the President, and a pleasant hour was spent in conversation and examining the specimens in the museum.

The Seventh Annual Bulletin was published and distributed as formerly. We are reminded to-night that at our last Annual Meeting the late lamented President, Dr. Botsford, was with us. Since then we have missed his kindly face and wise counsels at our meetings; we have also in the Treasurer's account a substantial token of the regard in which he held this Society.

In closing, the Council desire to express their hearty thanks to all who have assisted in forwarding the work of the Society.

Respectfully submitted,

W. J. WILSON,

*Secretary to Council.*

## BOTANICAL REPORT.

Mr. Brittain, now of the Normal School, Fredericton, and Mr. Philip Cox, of Newcastle, made a canoe trip down the Restigouche in July, 1888. Mr. Brittain, a member of the Botanical Committee, reports the following new or rare plants from this interesting region, not before traversed by botanists::

Clematis verticillaris.
Anemone parviflora.
Astragalus oroboides.
Collomia linearis.
Galium boreale.
Carex concinna.
C. alpina.
Pyrola minor.
Arabis Drummondii.
A. petræa.
Eleocharis pauciflora.
Salix longifolia.
Juncus alpinus, *var.* ——.
Selaginella selaginoides
Pinguicula vulgaris.
Aspidium fragrans.
Woodsia hyperborea.
W. glabella.
Phegopteris calcarea.

# DONATIONS TO THE LIBRARY.

| Date. | Donor's Name and Title of Book. |
|---|---|
| 1888.<br>*Feb.* | Publisher.—Journal of Comparative Medicine and Surgery. |
| | Ottawa Naturalist's Field Club.—January number, (April) Vol. I., No. XII., (May) October 1887, and February 1888, (October) July and August 1888, (December) Vol. I., No 7. |
| | Natural History Society, Montreal.—Canadian Record of Science, Vol. III., Nos. 1, 3 and 4. |
| | United States Geological Survey.—Mineral Resources of United States, 1886, (October) Atlas of Geography of Leadville. |
| | Prof. J. Macoun.—Catalogue of Canadian Plants, Part III. (October) Part IV. |
| | Author.—Catalogue of Canadian Birds by M. Chamberlain. |
| *Apr.* | E. Gilpin, Esq., C. E.—Quarterly Journal Geological Society London, No. —, (October) No. 175. |

## Donations to Library.—(*Continued.*)

| Date. | Donor's Name and Title of Book. |
|---|---|
| 1888.<br>*Apr.* | Nova Scotia Institute of Natural Science.—Vol. VII., Part I. |
| | Author. — Systematic table of Canadian birds, by M. Chamberlain. |
| | Santa Barbara Society of Natural History.—Bulletin No. I. |
| *May.* | J. Hoyes Panton.—Caves and potholes at Rockwood, Ont. |
| *Oct.* | Director Geological and Natural History Survey of Canada.—Annual Report, New Series, Vol. II. |
| | Smithsonian Institution.—Report 1885, Part II. |
| | U. S. Commissioner of Agriculture.—Report. |
| | Director National Museum, Brazil.—Archives, Vols. VI. and VII. |
| | Belfast Naturalist's Field Club.—Annual Report. |
| | Colorado Scientific Society.—Proceedings, Vol. II., Part III. |
| | Geographical Society, Leipzic.—Proceedings, 1887. |
| | New York Microscopical Society.—Journal, Vol. IV., No. 3, (December) No. 4. |
| | Geological Society, London,—Abstract of Proceedings, Nos. 510–526. |
| *Oct.* | Author.—How to study Botany by Dr. T. J. Burgess. |
| *Nov.* | Costa Rica National Museum.—Annals, 1887. |
| | Natural History Society, Glasgow.—Proceedings. |
| | Right Rev. Bishop Kingdon.—Archæological Map of Abury, Eng., British and Roman Antiquities of Wiltshire. |
| *Dec.* | Société Royale Malacologique de Belgique.—Proceedings. |
| | Academy Natural Sciences, Philadelphia.—Part II. (1888). |
| 1889. | G. F. Matthew.—Archaia, by Sir J. W. Dawson. |
| *Jan.* | American Museum of Natural History.—Annual Report, 1887–8. |

# DONATIONS TO THE MUSEUM.

| Date. | Donor's Name and Article Presented. |
|---|---|
| 1888.<br>*Feb.* | Miss Williams.—Cannon ball, Oromocto River. |
| | Mr. Anderson.—Minerals from Lake Superior. |
| | B. E. Paterson.—Fossils of Guelph Formation, 12 species, miscellaneous fossils, 30 species. |
| *April* | M. Chamberlain.—One pair school globes. |
| *May* | Mrs. M. M. Carr.—Glass sponge (*Euplectella*), from the China sea. |
| | Miss S. Jardine.—Botanical press. |
| | Geoffrey Stead.—Ripple-marked slab from St. John group, heads of trilobites (*Paradoxides pontificalis and suricoides*); shells (Mollusca) from oyster-beds and from St. John River. |
| *Oct.* | W. J. Wilson.—Introduced weed (*Achillæa ptarmica*). |
| | Geoffrey Stead.—Fossil shells and snails, 8 species. |
| *Dec.* | W. F. Best.—Manganese from Teny Cape, N. S. |
| | Howard McAdam.—Stone Arrow-head, Simpson's Island, N. B. |
| 1889.<br>*Jan.* | Robert R. Barnes.—Spider (Tarantula), from Mexico, Horned Toad from California. |
| | Rev. H. W. Winkley.—Mollusca, coast of Maine, 20 species. Fossil shells of Leda Clay, Maine, 10 species. |
| | W. F. Ganong.—Sponge, 1 species; Radiates, 8 species; Molluscoids, 1 species; Molluscs, 63 species; Worms, 1 species. Collected on coasts of New Brunswick. |

## OFFICERS OF THE SOCIETY FOR 1889.

*Patron*—His Honor Sir Leonard Tilley.

*President*—G. F. Matthew, M.A., F.R.S.C.

*Vice-Presidents*—Edwin Fisher, G. U. Hay, Ph. D.

*Treasurer*—Alfred Seely.

*Corresponding Secretary*—G. Ernest Fairweather.

*Recording Secretary*—W. J. Wilson.

*Librarian*—Miss M. E. Knowlton.

*Curators*—W. F. Best, R. P. Starr, S. W. Kain.

*Members of Council*—Jas. A. Estey, W. S. Harding, M. D., John Montgomery.

## STANDING COMMITTEES FOR 1889.

*Physics and Chemistry*—W. F. Best, G. U. Hay.

*Meteorology*—W. F. Best, G. Murdoch.

*Geology*—G. F. Matthew, L. W. Bailey, Ph.D., W. J. Wilson.

*Botany*—G. U. Hay, J. Brittain, J. Vroom.

*Entomology*—J. Brittain, Mrs. C. E. Heustis.

*Invertebrates*—W. F. Ganong, M.A., S. W. Kain, Geoffrey Stead.

*Fishes and Reptiles*—P. Campbell, S. W. Kain, W. S. Harding, M. D.

*Ornithology*—F. W. Daniel, A. Morrisey, Philip Cox.

*Library*—Miss A. P. Fitch, G. E. Fairweather, Thos. Stothart, Miss Knowlton, G. F. Matthew, G. U. Hay.

*Essays and Lectures*—G. F. Matthew, G. U. Hay, Jas. A. Estey, E. Fisher, J. Montgomery, W. J. Wilson.

*Publications*—G. F. Matthew, G. U. Hay, A. Seely, W. F. Best, G. E. Fairweather.

*Hall*—G. E. Fairweather, W. J. Wilson, G. F. Matthew.

*Finance*—A. Seely, Edwin Fisher, W. J. Wilson.

*Press*—G. U. Hay, G. E. Fairweather, G. F. Matthew.

I remain yours very truly

Ch. Ftz-Hart

# CHARLES FREDERICK HARTT.[1]

BY G. F. MATTHEW.[2]

It is now nearly twelve years since, to the surprise and sorrow of his friends, news came from Brazil of the sudden and untimely death of Prof. Charles Frederick Hartt; cut off in the midst of his noble work of making known to the world the Natural History and resources of the great Empire of Brazil.

He died in middle age with all the enthusiasm of youth upon him, with his life work giving promise of a glorious future. When we think of what he might have accomplished, had his life been spared, we cannot repress a feeling of regret at the loss which science has sustained in the death of this talented and devoted man.

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[1] Read before the Natural History Society of New Brunswick, 5th Nov. 1889.

[2] In the preparation of this paper I have quoted freely and verbatim from a sketch of the life of Professor Hartt written by Mr. G. [illegible]. Hay, and from the very excellent sketch prepared by Mr. Richard Rathbun, one of Prof. Hartt's assistants in Brazil. The present sketch is fuller, for his early life and a few incidents that have transpired since his death have been added.

Prof. Hartt was the eldest son of the late Jarvis William and Prudence (Brown) Hartt and was born at Fredericton, New Brunswick, August 23, 1840.

His father, Jarvis Hartt, on the completion of his education was appointed Principal of the Baptist Educational Seminary in Fredericton. He was noted for his earnest character and quiet devotion to educational work, and these qualities no doubt helped to mould the character of his son, and implant in him those habits of intense and continous application which he possessed. And to the fine temperament and high ideals of his mother we may believe that Prof. Hartt was largely indebted for the inspiration which carried him along in the study of Nature. Mrs. Hartt was educated at Cambridge, Mass., and came to Fredericton to take charge of one of the departments of the seminary where her future husband was teaching. Her intellectual training enabled her to appreciate her son's tastes, and in her he found a sympathetic and ready listener, when as school-boy and student he propounded to her his schemes for future study and work. Through her friends he found himself at home in later years in Cambridge, and frequently wrote to her of his plans and prospects.

Hartt's early education was carried on under the direct supervision of his father, who, for a long time was identified with the educational interests of Nova Scotia and New Brunswick. He studied at Horton Academy in Wolfville N.S. where his father was at the time professor, and afterward at Acadia College in the same town. In 1860 he graduated from the college with honor, receiving the degree of Bachelor of Arts, and later that of Master of Arts.

When still a boy, Hartt developed a strong taste for philology, and with the aid of transient people of the village near his home, would make vocabularies of Gaelic and Italian; and it was a day to be remembered by him when

Mr. Rand, the Micmac missionary, on his round visited Wolfville and taught him something of the Indian dialects.

Hartt's passion for Nature Science was not a late growth, for at the age of ten he showed a decided predeliction for Natural History and as he grew up took great delight in assisting Prof. Chipman of Acadia College in preparing and arranging his specimens. With the professor's aid and encouragement he made great progress in acquiring a knowledge of Mineralogy which, owing to the abundance of trap-minerals (zeolites &c.) in the vicinity, was a favourite study of the Professor of Acadia College and his pupils. Fortunately Hartt was not with Prof. Chipman when the latter made the trip by boat to the trap-cliffs of Blomidon, which cost him his life.

Hartt's versatility was shown in his talent for drawing, and for the acquisition of languages, and we are told that he became instructor in drawing in Acadia College when quite a youth. While at college he learned the elements of Portuguese from a shoemaker of the village, and this acquisition no doubt proved useful to him when he visited Brazil; he attained afterward such proficiency in this language that he lectured with great success to cultivated audiences in Rio Janeiro. His skill as a draftsman and his command of language always drew to his lectures interested hearers.

Already, while occupied with his college studies, he entered with zeal into the work of geological investigation. He explored the parts of Nova Scotia in the vicinity of the Annapolis Valley and the Basin of Minas, traversing the country on foot, and making large collections of specimens whenever the opportunity was afforded him. It was his intelligent eye and busy hands that selected in the Gaspereaux Valley the material which enabled Sir Wm. Dawson to establish the genus *Aneamites* on a remarkable fern of the Lower Carboniferous period, which, before that had been confounded with *Cyclopteris*. Many of the specimens of minerals and fossils which Hartt collected in those days, are to be found in the Museum of the Natural History Society at St. John, in the Peter Redpath Museum of McGill University in Montreal and at the Agassiz Museum in Cambridge. While engaged in his college studies, he also made a large collection of insects; and made meteorological observations for the Smithsonian Institution which have received much commendation.

While yet at Acadia College pursuing his studies, Hartt entered into correspondence with the author of this sketch, and before he graduated, we made a visit together to the mineral localities of Minas Basin and the adjacent shore of the Bay of Fundy, where the rich harvest of zeolites and showy varieties of quartz minerals, set free by the frost of winter, still attract numerous summer visitors. This visit was the beginning of a more intimate acquaintance, which was continued when Mr. Hartt moved to St. John.[1]

Later in this year (1860) Mr. Jarvis Hartt removed with his family to St. John for the purpose of establishing a Young Ladies High School, which he carried on successfully for many years. For some time his son aided him in conducting the school, but the son's love for his favourite studies was such, that every spare moment which could be snatched from the immediate duties of the school, was given to explorations in the neighborhood of the city, and the gathering of a rich harvest of fossils from the ballast of vessels, arriving from the west coast of Ireland, the Mediterranean and elsewhere.

When Mr. Hartt came to St. John, but little was known to the Scientific World of its geology. Some twenty years previously the late Dr. Abraham Gesner, then employed on the Geological Survey of New Brunswick, had traversed the neighborhood of the city of St. John, and had referred the rocks of that vicinity to the "Grauwacke Formation," with the reservation that certain portions near the city were "imperfect coal measures." He made the latter part of this statement in consequence of the discovery of a fossil tree in the sandstones East of the city. Dr. Jas. Robb of King's College, Fredericton, the successor of Dr. Gesner in the study of the geology of New Brunswick, pronounced the same rocks some years later to be Upper Silurian. It remained for Mr. Hartt and his *collaborateurs* to amass the materials which, in the hands of the sagacious Principal of McGill University, were to show that these plant-bearing sandstones contained a Devonian flora.

The writer had already found in these beds a sufficient number and variety of species to enable Sir Wm. Dawson to pronounce upon their Devonian age, but the rich harvest of fossils—exquisitely preserved ferns, asterophyllites, and psilophyta were not discovered until Mr. Hartt entered the field. To the collection and observation of these plants he gave the whole of his vacations during the years 1861, '62 and '63; and the result of this work has been of the most enduring value to science. Every bed of the unique section at the "Fern ledges" in Lancaster, West of St. John, was carefully studied, its fossils collected and its remains recorded. Such a work had not been done before in the Maritime provinces of Canada. The thoroughness of the work will be seen from the fact that while Hartt discovered scores of species in these beds, no new species of plants have been added to those which crowned his researches, and remains of only two insects beside those he found.

The discovery of insects of such great antiquity was perhaps the most striking result of these investigations. A few insects mostly related to the cockroaches had previously been found in the Coal Measures in several countries, but Hartt's discovery of insect wings in these older rocks threw a new light upon the history of insect life in the first geological ages. These insects were of five species, and were placed in the hands of Dr. S. H. Scudder of Boston for study. He referred them all to the Neuroptera; in part to new, in part, doubtfully, to old families, and suggested that some of the forms were synthetic types. But their important bearing on the history of insect-life was not then fully reached by that sagacious and experienced student of insects, for he has since referred them all to a great Palæozoic order, now quite extinct, the Palæodictyoptera of Goldenberg, from which he conceives that all the modern orders of insects have arisen.

Plant remains and insects, however, were not the only organisms discovered by Mr. Hartt in these interesting beds, for crustaceans also were found. These were of peculiar types and others found since in the same beds are not less remarkable.

Hartt's restless energy would not allow him to be content with field work alone, so in conjunction with several other young men of kindred tastes, in the city of St. John, he formed the "Steinhammer Club" an association devoted to the study of Geology. Subsequently at the suggestion of Sir Wm. Dawson of Montreal, this club was changed into a public society under the name of the Natural History Society of New Brunswick, whose meetings have been the means of sustaining an interest in the natural sciences in St. John, and in whose publications are recorded much that is of value relating to the Natural History of the Province of New Brunswick.—In this society Mr. Hartt took the warmest interest, attending its meetings, reading papers germain to its object, and devoting much material and time to the enlargement and arrangement of its museum.

Absorbed as he was in geological studies Mr. Hartt could not long remain content with his work in the High School. Accordingly he resolved to seek a larger field for study and work. Prof. Louis Agassiz had then recently come to America, and had already become widely known on this continent, as a successful teacher and instructor in Natural History. To his Zoological museum Mr. Hartt resolved to go in order to complete his studies. He sold his Devonian collections to the Natural History Society of New Brunswick, and proceeded to Cambridge to avail himself of the great stores of material for study in Agassiz Museum, and to obtain instruction from that talented and most attractive teacher of Natural History. Here, with such kindred spirits as Verrill, Morse, Putnam, Hyatt, Scudder and St. John, he devoted himself for several years to the investigation of Nature under the intelligent eye of Agassiz.

The writer of this sketch had meanwhile commenced the study of the older slates at Saint John, whose age hitherto had not been determined, but which were supposed to be a downward continuation of the measures which contained the Devonian plants. At first only some badly preserved trilobites were found, which, on account of their long thoraces were supposed to be of Lower Silurian age.[1]

Subsequently (1863) much better material of well preserved species of trilobites were found by the author in Portland (St. John) and these, with the collections of the Geological Survey of Southern New Brunswick, were placed in Mr. Hartt's hands for study. Taking advantage of the opportunities which he possessed at Cambridge, he gave these fossils a careful scrutiny, and was able to announce that they were equivalent in age to those of Etagé C. of M. Barrande and, therefore Primordial. After his first brief notice in the report of the Geological Survey of New Brunswick, announcing this discovery, Hartt continued his study of these organisms with the aid of additional material. Upon this material, together with what had been previously obtained, was bȧsed his fuller descriptions of the fossils, with many figures, which appeared in Dr. (now Sir Wm.) Dawson's Acadian Geology in 1868.

In 1864 Mr. Hartt and the author were invited by Professor L. W. Bailey, to take part with him in the Geological Survey of Southern New Brunswick instituted by the Provincial Government. The results of this survey were published in the following year, and were a very important addition to the knowledge of the geological structure of this part of New Brunswick. The results embodied in this report, formed the basis from which the Geological Survey of Canada in this region, after the confederation of the Canadian provinces, was carried on.

Beside his work on this survey in New Brunswick, Mr. Hartt did independent geological work in Nova Scotia. In 1864 he obtained proof of the pre-carboniferous age of the gold of Nova Scotia. His observations were made at Corbitt Mills, where the well-known auriferous slates are immediately overlaid, unconformably, by conglomerates, grits, and sandstones of Lower Carboniferous age. The lower portion of these rocks contains an abundance of gold, which was undoubtedly extracted from the underlying slates, while the former deposits were in process of formation, and was mixed with the loose gravelly material, which subsequently became consolidated into the conglomerate and sandstone.

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[1] At that time the Cambrian had not by common consent, been separated from the Lower Silurian.

We owe to Hartt also, the careful investigation of the relations of the different members of the carboniferous limestone deposits in the neighborhood of Windsor, Stewiacke, &c. in Nova Scotia. He collected and studied the fauna of each separate set of beds with much pains, and in this way was enabled to determine their sequence. The fossils which are marine, are very numerous, and some new species were described by him in the "Acadian Geology." Much interest attaches to the study of this formation at the above localities, where, in the upper beds, occur many forms common to both the Carboniferous and the Permian, and a great likeness is apparent to the upper members of the Carboniferous system in the western United States, called Permo-Carboniferous. Dr. Meek, who examined the fossils, suggested that we might have here what Barrande would call an upper Coal-Measure or even Permo-Carboniferous fauna, 'colonized' far back in the Sub-carboniferous period. Dr. (Sir Wm.) Dawson has enlarged on Hartt's results, and shows that the divisions made by him are of more general application than Hartt had known them to be.

As early as this, Hartt developed a constitutional tendency to asthma, which interfered with his field work in the cold and humid climate of this region, and which, after he entered on his professional work in the United States, prevented him from revisiting his native land. This, probably, was one of the causes which induced him to seek occupation in the warmer climate of Brazil.

Upon the organization of the Thayer Expedition to Brazil, by Prof. L. Agassiz, Mr. Hartt was appointed one of its two geologists, Mr. Orestes H. St. John being the other. This expedition left New York in April 1865 and returned in July 1866, having been absent a little more than a year. This was the strong and final inducement that called Hartt away from the geology of his own country. Although he was not fortunate in finding a very rich geological territory during his wanderings while connected with the Thayer Expedition, he saw enough to thoroughly interest him in returning again to Brazil, and in finally giving his whole attention to Brazilian studies.

The primary object of the Thayer Expedition was to investigate the distribution of the fresh water fishes of Brazil, but much time was also devoted to its geology. Prof. Agassiz limited himself mostly, in his geological work, to the examination of the superficial deposits at Rio de Janeiro and on the river Amazon, which were studied in connection with the question of glaciers. Hartt was retained near Rio for some time, in making examinations of the many Railroad cuttings around that city. After this work was completed, his field of exploration lay mostly between Rio and Bahia, where he carefully studied the geological and other features of the coast, and of the principal river basins leading to it. Large collections of the fresh water fishes of the rivers, and of the marine animals of the coasts and reefs were made. In consequence of the absence of fossils, no results in systematic geology were obtained, but, nevertheless, Hartt's studies of the geology of this monotonous tract were of great interest.

In the neighborhood of Porto Seguro he explored the coral and sandstone reefs, the latter of which is a prominent feature of the Brazilian coast. He was the first to carefully work out the structure and mode of formation of these sandstone reefs.

After Hartt had returned to the United States from the Thayer Expedition, he felt that he had left unfinished some of the more important investigations he had made in Brazil. He was unable to report as fully as he wished, on many subjects of interest which he had partly studied. So in 1867 he returned to Bahia, to perfect his former work and to continue his observations. He worked out the geology on the line of the Bahia railroad in detail, and collected some fossils from the Cretaceous terreins of that region. He also studied the structure of the Abrolhos islands and reefs which lie off the coast of Bahia. The islands are of stratified deposits, capped with trap, while the reefs, which had never been to any extent examined by a naturalist, are of coral, generally assuming curious tower-like forms, and often growing together to form a large connected expanse.

In addition to throwing new light on the formation of certain kinds of coral reefs, he also discovered a large number of species of corals of which the majority were new, but belonged to West Indian types. The absence of many prominent West Indian genera such as *Madrepora*, *Meandrina*, *Diploria* &c. was noted by him. The Cretaceous region of Sergipe was visited and yielded many fossils, which have been in part described by Prof. Alpheus Hyatt.

In the short interval which elapsed between his first and second trip to Brazil, he was engaged in scientific teaching and lecturing in and near New York city, at the Cooper Institute, Pelham Priory, Adelphi Academy and other places where he attained much success, and made many warm friends who aided him in his second Brazilian expedition. In 1868, soon after returning the second time, he was appointed Professor of Natural History in Vassar College; but he resigned this position in the autumn of the same year to accept the chair of Geology in Cornell University, where he was retained at the head of the department of Geology until the time of his death. In 1869 he was elected General Secretary of the American Association to serve at the meeting of 1870, but before that time he had departed on his third trip to Brazil.

It was in the year 1869 also, that he was married to Miss Lucy Lynde of Buffalo, N. Y., by whom he had two children, a son and a daughter. Both his widow and children are living. His son, now in his twenty-first year, is studying at Williams College, Mass., and his daughter at the

Buffalo Seminary, Buffalo, N. Y., of which her mother, for several years past, has been the principal.

While at Cornell University, when not occupied with college duties, he was engaged in working up the results of his Brazilian explorations, and in preparing his report as geologist of the Thayer Expedition. This report, however, grew to so great a size, and was so complete in itself, that it was found advisable to publish it separately in 1870 as "The Geology and Physical Geography of Brazil." It forms a large octavo volume of over six hundred pages, and contains in addition to an account of his own researches, a *résumé* of our previous knowledge of the natural history of the country. It is thus not limited to a discussion of the subject indicated by the title, but treats of the topographical and general features of the country, of its flora and fauna, both marine and terrestrial, and of its mining, agricultural, commercial and manufacturing interests. The numerous maps and sketches which illustrate it, were drawn by Professor Hartt himself, and the greater part of them represent regions never before depicted. The volume closes with a valuable appendix on the Botecudo Indians.

In the year 1870, the same in which his book was issued, Professor Hartt organized the largest of his own expeditions from the United States. It was composed, beside himself, of Professor Prentice and eleven students of Cornell University. His object in taking so many young men was to give them thorough practical training, and to stimulate them to undertake original work. He says in his report of this expedition, that he did not expect to make scientists of them all, but hoped that some of them might thus be induced to accept this calling. The means for defraying the expenses of the trip were contributed by several parties, the most prominent of whom was Mr. E. B. Morgan of Aurora, N. Y. whose name has been given to this and the subsequent expedition.

Prof. Hartt determined on this occasion, to change his field of research, and explore the Amazonas. Accordingly he went with his party direct to Pará, and in the neighborhood of this city, spent some time in training his inexperienced assistants. The tributary rivers Tocantins, Zingú and Tapajos, were then examined throughout their lower courses, and many valuable geological facts ascertained. On the Tapajos were discovered highly fossiliferous carboniferous deposits.

At the falls on each of the above named rivers were found series of metamorphic rocks, which, from their position and lithological characters, have been referred to the Silurian system. Passing to the North side of the valley of the Amazonas they minutely investigated the geology of the vicinity of Monte Alegre and the Sierra Ereré. On the plain of Ereré were discovered sandstones and shales, with characteristic Devonian fossils, corresponding more or less with those of the Hamilton and Corniferous groups of New York State. These were the first Devonian fossils found East of the Andes in South America.

One of the party examined the ancient Indian mounds of the island of Marajó at the mouth of the Amazonas, at that time only imperfectly known, and discovered large quantities of richly ornamented pottery, mostly in fragments These have since been made the subject of considerable study by Prof. Hartt and others. The sea coast was examined at several points, from Pará to Pernambuco, and in the neighborhood of the latter city, the fossiliferous Cretaceous formations of the province of the same name, were studied for the first time. At all the localities visited, they made large collections in geology and zoology, which were sent to the United States, and are now contained in the museum of Cornell University.

Prof. Hartt's researches on the Amazonas did not tend to bring proof of the former existence of glaciers there. The sierra of Ereré was found not to belong to the series of table-topped hills, as Professor Agassiz had been led to suppose, but to consist of inclined strata of very irregular outline. The Devonian fossils of the plain were from a portion of the supposed "drift" material of Agassiz.

Professor Hartt returned to Ithaca, N. Y., January 1872, where he remained two years and a half, giving all the time he could spare from his college duties to working up the results of his two Amazonian trips, with the aid of his two assistants, Orville A. Derby and Richard Rathbun. His reports were published as soon as finished, in the journals of several scientific societies. During this time he also gave popular lectures on Brazil in New York, Boston and Syracuse.

But Professor Hartt was unable to continue long in this state of comparative quietude. In bringing together the result of his several trips to South America, with the object of explaining the geology of all Brazil, he saw how meagre were his data for this purpose, notwithstanding all that he and others had recently done toward elucidating the structure of this vast region. He wished to extend his researches and conceived the idea of organizing a survey of the whole Brazilian Empire, which has an area scarcely less than that of the United States. There was only one way of accomplishing such an undertaking; it must be supported by the government. Hartt ventured to bring the matter before some of his Brazilian friends, and his ideas met with such favour that in 1874 he received an unofficial invitation from the Brazilian minister of Agriculture, to submit a proposition for the systematic geological exploration of the Empire. In August of the same year, he accordingly went to Rio de Janeiro for the purpose of formally presenting his plans. Upon arriving at that city he was received with almost as much enthusiasm as was Prof. Agassiz nearly ten years earlier. His thorough acquaintance with the language of the country enabled him to communicate freely with the people, and he soon found himself encircled with friends, who gladly gave their influence in advancing his plans.

A Geological Commission of the Empire of Brazil was organized on the 1st May 1875 with Prof. Hartt as chief, and the following assistants E. F. de Jordão, Engineer, O. A. Derby and Richard Rathbun, Assistant Geologists and F. G. de Freitas, "Particante." Mr. John Branner, now in charge of the geological survey of Arkansas, was soon added to the staff, and a few other additions and changes were made.

The active work of the Commission began in June 1875, and the coast region North of Rio to Cape San Roque was explored. Here extensive cretaceous deposits were found, with remains of sharks, crocodiles and other reptiles; and large collections of recent marine animals were made along the coast.

In the next year, the work in the maritime provinces North of Rio was continued and abundant remains of reptiles, fishes, and other animals were found. The diamond-bearing gravels near Bahia were also examined for the purpose of discovering the source of these gems. In the province of Sergipe was gathered a rich harvest of cretaceous fossils for the museum at Rio.

In this and the following year (1877) explorations were carried on in the provinces South of Rio, where Carboniferous and Devonian or Silurian deposits were discovered, rich in fossils, and the gold regions of this part of the empire and of Minas Geraes were examined by Mr. J. E. Mills.

While this work was in progress in the South, Mr. Derby was arriving at important results on the Amazonas, where he proved the existence of an immense basin of Palæozoic rocks with carboniferous deposits occupying an extensive area in the centre, surrounded by Devonian and Silurian beds rich in fossils. Owing to the dense vegetation of the lowlands of the valley of the Amazonas, they were unable to discover whether these Carboniferous rocks held deposits of coal or not. Immense collections of geological, zoological and ethnological specimens were sent to the capital by the various exploring parties, and it was found necessary to set apart a large house to contain them.

In June 1877, prompted by motives of economy, and unacquainted with the amount and value of the work being done by the Commission, the Government gave orders for the temporary suspension of the Commission on the 1st of July. The Emperor, soon after returning to Rio, fresh from the Museums of the Old World and North America, carefully inspected the building and work of the Commission. He showed a just appreciation of the value of the new Museum of Geology, both to his own country and to the world at large; he was generous in his words of praise to the talented chief, who had so dearly earned them, and declared that the work should go on.

In the beginning of the following year, an entire change was made in the Ministry of Brazil, and before the several departments had been entirely re-organized, and the appropriations determined upon, Professor Hartt died. There was no one to succeed him, and his large collections were placed in the care of the National Museum at Rio de Janeiro. It is expected that steps will be taken by the Brazilian Government at an early date, toward publishing the many reports which were finished under the direction of Prof. Hartt.

It would appear that before the researches of Professor Hartt, the systematic geology of vast areas of Brazil, was an utter blank. The Carboniferous system was known to exist in the South of Brazil, and some Palæozoic fossils had been found on the Tapajos R. in the North of the Empire; the Cretaceous formation had been recognized on the eastern coast, but it remained for Hartt to exhibit the general geologic structure of extensive areas of the Empire, and to recognize wide spread formations of Upper Silurian, Devonian, Carboniferous and Triassic (?) age. He also divided the vast areas of metamorphic rocks in Central Brazil into Eozoic and Lower Silurian by their lithological aspect and other characters.

Nor did he confine his studies to Geology alone, for in addition to voluminous reports on this subject, he had the following works nearly or quite ready for publication

I. Brazilian Antiquities,—about 500 pages, 4 to.
II. Mythology of the Brazilian Indians,—about 300 pages 4 to.
III. Grammar, Dictionary &c. of the Tupé Language, 400 pages.
IV. An Album—of about 100 photographs, illustrating the country, people &c. of the Lower Amazonas. With about 100 pages of text.

Prof. Hartt's scientific career may be said to have covered a decade and a half, and one can only wonder at the marvellous industry which crowded what might well be considered the work of an ordinary life-time into this short period. Only those engaged in his enterprises knew the variety and excellence of his scientific work, or could appreciate the skill with which he directed the operations first of his exploring parties in Brazil, and then of the Geological Survey of that vast region. Judging from his brilliant beginning, we may confidently assert that, had he not been cut off in his prime, he would have accomplished a work that would have placed him beside the greatest of the geological investigators of the present century.

None but the hardiest constitution could stand the great strain which Hartt laid on his physical powers, and under the exhausting heat of a tropical climate he finally succumbed. Having been on an exploring expedition inland, he came out upon the coast at Rio de Janeiro tired and worn out by physical toil and mental anxiety; the latter due to the difficulties in which the Survey had been placed by changes in the administration of the country. Here he was attacked by that formidable scourge of the lowlands of tropical America—yellow fever. His exhausted system could not withstand the disease. His illness was of scarcely more than two days duration, and he suddenly (and unexpectedly to those who were watching him) passed away in the early morning of Monday 18th of March 1878.

Prof. Hartt was a man of winning manners, affectionate disposition and generous nature, and was greatly esteemed by his scientific associates. He was gifted with an original and inventive mind, and indefatigable industry. The Christtian training of his early home, and the stimulating influences of the educational institutions where he spent the first years of his life, no doubt served largely to form his character. His death terminated the Geological Survey of Brazil, as no one was thought worthy of taking the mantle which fell from him. His assistants remained to work up the material which he had gathered; but the leading mind which had inaugurated the Survey was gone, and further investigation of the physical structure of Brazil with governmental aid is left to the enterprise of another generation.

Since Professor Hartt's death, two volumes of the Archives of the National Museum of Brazil have been published, which testify to the extent of his labors. The first (No. VI.) contains an account of the Archæology and Ethnology of the tribes of the Amazonas, based on observations made by Prof. Hartt and his assistants on the shell-heaps, the cemeteries and the artificial mounds of that region, and contains descriptions and figures of the articles found in these repositories of the relics of its pre-historic people. It contains also an essay on the origin of art, and the evolution of ornamentation as exhibited by their pottery &c.; as well as an account of certain tribes of the region and their mythology.

In the remainder of the volume the result of Prof. Hartt's work stands out on many a page, especially in the very interesting memoir by Dr. Ladislaus Netto on the Archæology of Brazil. The material collected under Prof. Hartt's direction at the island of Marajó and at Maracá, are largely used by Dr. Netto in illustrating his memoir.

The succeeding volume of the Annals of the Museum (No. VII.) is devoted to a description of the Cretaceous Mollusca of Brazil by Dr. C. A. White of the geological survey of the United States. This voluminous memoir, published in Portuguese and English, is also based on the material collected under Prof. Hartt, when in charge of the geological survey of Brazil.

Several years after his death, the remains of this devoted man were removed from Brazil to Buffalo, N. Y., the home of his widow, where they now lie in a cemetry on the shore of Lake Erie.

Since his death, a tablet to his memory has been placed in the library of Acadia College (his "alma mater"). This tablet was set up by his classmates in commemoration of his great services to Science. On the unveiling of the monument, June 1884, one of their number, Dr. Silas Alward, paid a high tribute to the character and worth of their deceased companion in an oration before the faculty and friends of the college.

The following is a list of the scientific writings of Professor C. F. Hartt as far as known to me:—

1. The Gold of Nova Scotia of Pre-Carboniferous Age. Canadian Naturalist, 1, No. 6, 459–461, 1864.

2. Observations on the Geology of Southern New Brunswick, made principally during the Summer of 1864, by Prof. L. W. Bailey and Messrs. George F. Mathew and C. F. Hartt; prepared and arranged, with a Geological Map, by L. W. Bailey, A.M. Contains the three following reports by C. F. Hartt:—

(a) Preliminary Notice of a Fauna of the Primordial Period in the vicinity of St. John, N. B., pp. 30–31. (Published also in Can. Nat., VII, 318-320 1865; and in Dawson's "Acadian Geology," 2nd Ed., 1868, 641–643.)

(b) On the Devonian Plant Locality of the "Fern Ledges," Lancaster, New Brunswick, with a detailed Section, and Notes on the Fossils, 131–141. (Includes report of S. H. Scudder on the Devonian insects. An abstract was published in "Acadian Geology," 1868, 513–523.)

(c) List of New Brunswick Fossils, 143–147.

3. The recent Bird-Tracks of the Basin of Minas. American Naturalist, I, 169.176, 234.243, 1867.

4. On a Sub-division of the Acadian Carboniferous Limestones, with a desciption of a section across these Rocks at Windsor, N. S. Can. Nat., III, 212-224, 1867. (A summary of the results recorded in this paper are given in "Acadian Geology," 1868, 279–280.)

5. [Descriptions and Notices of the Trilobites and other fossils of the Acadian Group, at St. John, N. B.] "Acadian Geology," 1868, 643–657, with many figures. (Prepared by Dr. Dawson from the MS. notes of Prof. Hartt.)

6. Résumé of a Lecture on the "Growth of the South American Continent," delivered before the Library Association, Ithaca, N. Y., Dec. 4. 1868. Cornell Era, Dec. 12, 1868. (Pamphlet reprint contains 8 pages.)

7. A Vacation Trip to Brazil. Amer. Nat., I, 642–651, 1868.

8. A Naturalist in Brazil. Amer. Nat., II, 1–13, with illustrations, 1868.

9. The cruise of the "Abrolhos." Amer. Nat., II, 85–73, with illustrations, 1868.

10. On the Botocudos of Brazil, (abstract). Proceed. Amer. Ass. Adv. Sci., 18th meeting, Salem, 1869, 273–274.

11. Thayer Expedition.—Scientific Results of a Journey in Brazil, by Louis Agassiz and his Travelling Companions.—Geology and Physical Geography of Brazil, by Charles Fred. Hartt, with illustrations and maps, 8°, pp. 620. Boston, Fields, Osgood & Co., 1870.

12. Discovery of Lower Carboniferous Fossils on the Rio Tapajos, (A letter written near Monte Alegre, Rio Amazonas, Oct. 5, 1870.) Amer. Nat. IV, 694–695, 1871.

13. Devonian Rocks in the Amazonian Valley. Amer. Nat., V. 121-122, 1871.

14. Amazonian Drift. Amer. Jour. Sci. and Arts, I, April 1871, 294–296.

15. Braz. Rock Inscriptions. Amer. Nat., V, 139–147, with 9 plates, 1871.

16. The Ancient Indian Pottery of Marajó, Brazil. Amer. Nat. V, 259–271, with numerous figures, 1871.

17. Recent Explorations in the Valley of the Amazonas, with Map. Jour. Amer. Geogr. Soc., N. Y., III, 1872, 231-252, (read May 16, 1871).

18. [The Origin of the Basin of the Amazonas (abstract).] Proc. Boston Soc. Nat. Hist., XV, 153–154, 1872.

19. On the Tertiary Basin of the Marañon. Amer. Jour. Sci. and Arts, IV, July, 1872, 53-58.

20. On the Occurrence of Face-Urns in Brazil. Amer. Nat. VI, 607–610, with one large figure, 1872.

21. Notes on the Lingoa Geral or Modern Tupí of the Amazonas. Trans. Amer. Philog. Ass., 1872, pp. 20.

22. O Mytho do Curupira. Aurora Brazileira, Ithaca, N. Y., Oct. and Nov. 1873. (Also separate reprint, pp. 12.)

23. Morgan Expeditions 1870–71.—Contributions to the Geology and Physical Geography of the Lower Amazonas. The Ereré-Monte-Alegre District and the Table-Topped Hills. Bull. Buffalo Soc. Nat. Sci., I, No. 4, 201-235, with maps and sketches. 1874.

24. Preliminary Reports of the Morgan Expeditions, 1870–71.—Report of a Reconnoissance of the Lower Tapajos. Bull. Cornell University Society (Science), No. 1, pp. 37, with map, 1874.

25. Evolution in Ornament. Popular Science Monthly, January, 1875, 266–275, with many figures.

26. Morgan Expeditions, 1870-71.—On the Devonian Trilobites and Molusks of Ereré, Province of Pará, Brazil; by Ch. Fred. Hartt, and Richard Rathbun. Ann. Lyc. Nat. Hist., N. Y., XI, 110-127, May, 1875.

27. The Indian Cemetery of the Gruta das Mumias, Southern Minas Geraes, Brazil. Amer. Nat., IX, 205-217 (illustrated), 1875.

28. Amazonian Tortoise Myths. Rio de Janeiro, Wm. Scully, Publisher. 1875, pp. 40.

29. Notes on the Manufacture of Pottery among Savage Races. Published at the office of the "South American Mail," Rio de Janeiro, 1875, pp. 70.

30. Exploraçoes Scientificas,—I. Commissão Geologica do Brazil. Catalogo da Exposição de Obras Publicas do Ministerio da Agricultura, Rio de Janeiro, 1876, 96–106.

31. Nota sobre Algumas Tangas de Barro Cosido dos Antigos Indigenas da Ilha de Marajó. Archivos do Museu Nacional do Rio de Janeiro, I. Trimestre I°, 21–25, Estampas III, IV & V, 1876.

32. Descripçao dos Objectos de Pedra de Origem Indigena Conservados no Museu Nacional. Arch. do Mus. Nac. do Rio de Janeiro, I, Trim. 2° & 3°, 45–53, Estampas VII & VIII, & 2 figuras, 1876.

33. The Geological Survey of Brazil. First Preliminary Report made to the Counselor Thomaz José Coelho de Almeida, Minister and Secretary of State for Agriculture, etc.; by Ch. Fred. Hartt, Chief of the Geological Commission of the Empire of Brazil, Rio de Janeiro, 1876. Translated and abridged by Prof. T. B. Comstock. Amer. Jour. Sc. and Arts, XI, June, 1877, 466–473.

(Posthumous).

34. Contribuições para a ethnologia do valle do Amazonas, par C. F. Hartt. In Archivos do Museu Nacional do Rio de Janeiro, Vol. VI, 1885.

# SUPPLEMENT.

Dr. J. C. Branner, Director of the Geological Survey of Arkansas, has recently written an account of "Prof. Hartt in Brazil." This appeared in the "Cornell Magazine," Ithaca, N. Y., February 1890, and as it gives that author's impression of the life and work of Prof. Hartt, I have made extracts from the article, seeing that it gives an opinion of his character and achievements formed by one who was an intimate associate in his later years.

"Hartt was a man of the broadest sympathies. One of his peculiarities that always impressed me, was the various sides of his character as they appeared to different ones of his most intimate friends. Among his assistants on the Brazilian Survey were men of the most diverse temperaments and tastes, and Hartt always and instinctively approached and dealt with these various characters in the most effective manner. He never acted so out of diplomacy, but out of sympathy; he put himself in accord with the person with whom he had to deal, and the result was that his assistants, and indeed everyone who came in contact with him, felt drawn towards him. With such a man only the most cordial and genial relations were possible. He had a keen appreciation of wit, humor, and of the ridiculous, and as there was much in common between us on this point, he invariably related to me whatever impressed himself as amusing. . . . .

Every artist or musician who met Hartt knows of his love for art and music. These tastes were always turned to good account in his scientific work. No one who had really studied those matters so little, could have seized more promptly or more intelligently the ethnologic meaning of the art and music of savages with whom he occasionally came in contact. His love for music gave him and those of us around him a great deal of pleasure. The Brazilians, being naturally very fond of music, had every year some of the best musical talent of Europe at the Imperial Opera House, and frequent attendance at the opera broke for him the strain and worry of official responsibility.

His liking for languages was equally marked, and he never missed an opportunity to learn something of them. . . . . In Brazil he became interested in the languages of the native Africans, and never lost a chance to learn a new word or idiom, or to make use of his knowledge. In such cases as these, the affair was of course but little more than a pastime, but when he came in contact with the native Brazilian races he applied himself to the study of their languages in all seriousness, with the result that he soon came to be one of a very few Tupi scholars, and accumulated much material upon the native Brazilian languages.

Ethnologic studies interested him deeply, and his work led him more and more in that direction. Had he lived, I have no doubt he would eventually have devoted himself entirely to the study of South American ethnology. . . . .

Hartt's strong points were enthusiasm and versatility. . . . He loved scientific work for its own sake and with all his heart, and he could scarcely entertain the idea of abandoning it for the administrative duties of chief of the Geological Survey. He tried hard to do both and found it impossible; he became very nervous and suffered greatly from insomnia. On several occasions I have stayed with him all night trying, with but poor success, to divert his mind from the affairs that annoyed him most. At such times he scarcely closed his eyes during the entire night.

It is not difficult to sum up Hartt's influence upon geological work in Brazil, for with very few exceptions all the work of this character which has been done in that country since 1874 is traceable, either directly or indirectly, to the impetus given it by Hartt. For the most part the work has been done by some of Hartt's students and assistants, and as he was not a narrow specialist, but a broad-minded naturalist, his students have also done other than purely geologic work. Hartt's own writings on Brazilian topics number twenty-eight titles, one of which—his "Geology and Physical Geography of Brazil"—is an illustrated book of 620 pages.

Mr. O. A. Derby, Hartt's first assistant on the Brazilian Survey, was, after some delay, appointed assistant director of the National Museum, where he has been able to carry on more or less geologic work ever since the suspension of the Survey in 1877. During the past few years he has been director of a geological survey of the province of Sao Paulo, where he is successfully carrying out in detail for that province the very work that Hartt hoped to accomplish for the empire. Mr. Derby's published papers upon Brazilian geology number at least fourteen titles, and he now has in press the results of the operations carried on under his direction in the province of Sao Paulo. His geologic work is the most thorough that has been done thus far in Brazil, almost all that has been done hitherto partaking more or less of the nature of reconnoissances."

[One of the latest contributions to geological literature, arising from the explorations of Prof. Hartt in Brazil, is a beautiful memoir on the Trilobites of Ereré and Maecurú, by Dr. John M. Clarke of the State Museum at Albany, N. Y. This work has been published at Rio under the auspices of the National Museum of Brazil, and shows very clearly the value of trilobites as guages of geological history. The brachiopodous shells from the sandstones of the two localities above named, described by Richard Rathburn, synchronized the sandstones of those places with the Middle Devonian of New York, etc. But a study of the trilobites of the two localities compels a modification of this view; for while the trilobites of Ereré have a Middle Devonian aspect, those of Maecurú find their nearest relatives among the lowest Devonian species, or even with the trilobites of the upper part of the Silurian system. Dr. Clarke's essay contains many profound generalizations on the relationship and descent of the species of trilobites of the genera Homalonotus, Phacops and Dalmanites.—G. F. M.]

"Richard Rathburn, now of the Smithsonian Institution, was a member of the Brazilian Survey from 1875 until its work was suspended. He has published nine important papers upon the natural history of Brazil,—results of his work under Hartt. Frank D. Y. Carpenter published two works, one upon methods of geographic work and the other a popular book. Herbert H. Smith has published two books, one of which is the most important popular work that has appeared upon Brazil since that of Mrs. Agassiz. The writer has published twenty-one titles on Brazilian topics. But the publications of these five assistants do not represent the full extent of their work, for, with the exception of Mr. Carpenter, who died in 1883, these men are all active workers, and many of the results of their observations in Brazil still remain to be published.

Other papers, based upon collections made by Hartt and his assistants, have also been written by various authorities. The most important of these is Dr. C. A. White's "Contributions to the Paleontology of Brazil," published in 1887, and beautifully illustrated. This work describes 315 species of mesozoic fossils collected by the Brazilian Survey. Other contributions are Marsh, Hyatt, Cope, Verrill, S. I. Smith and T. B. Comstock.

But Hartt's good influence has done even more for Brazil in keeping up the tone and character of scientific work than in the results thus far published. A country situated as Brazil is, far removed from the centres of scientific activity, is often the prey of the grossest forms of scientific charlatanism. Hartt and his assistants naturally came in contact with this class of men, but he so impressed the leading men of the empire with his ability and integrity that charlatanism was never able, in his presence, to make much headway.

That Cornell University has had so long a number of Brazilians among her students is to be attributed either directly or indirectly to Hartt's influence; and whatever helpful, broadening, enlightening aspirations these young men may take with them from Cornell, they should bear in themselves some remembrance — some *saudade* — of Prof. Hartt who laid down his life for science in Brazil."

In conclusion I should express my thanks to those who have aided in obtaining the information upon which the preceding sketch of the life of Prof. Hartt has been based; and my thanks are especially due to his brother, Mr. George Hartt, of New York, who kindly loaned the wood-cut which faces the title-page. The cut was made by Mr. Hartt himself, and is considered a faithful likeness. The autograph is from a letter to Mr. J. B. Hegan, written when Hartt was a student at Cambridge, and when he gave more expression to his signature than he did in later years.

# PRESIDENT'S ANNUAL ADDRESS.

1. INTRODUCTION.—2. ON THE PALÆOZOIC INSECTS.—3. ON THE EXISTENCE OF ORGANISMS IN THE PRE-CAMBRIAN ROCKS.—4. RECENT ADDITIONS TO THE MUSEUM AND LIBRARY.

With many societies such as ours it is customary for the outgoing president to address his fellow members on some topic which has formed the subject of his own studies, or to review the progress of science during the preceding year; it is therefore my privilege as the presiding officer of your society to address to you a few farewell words.

Without attempting anything more than the briefest references in either of these directions, I propose to make some remarks to you on two geological discoveries, which, while they are of local interest, also have a wider significance. But I would first call your attention to the more immediate interests of our association.

Our recording secretary has prepared an annual report of the doings of the society, and of its financial standing, which will be submitted to you; and it therefore seems unnecessary for me to review these matters.

But I may say that the society is doing a continuous and useful work in advancing a knowledge of the natural history of the province. It is daily becoming more of a centre of reference for information on such subjects, and I have no doubt that as it becomes better known its usefulness in this respect will increase.

We have had seasons of zeal which have culminated in sending a Hartt to Brazil, and a Chamberlain to Cambridge; and we have had intervening periods in which the interest of the members in the objects of the society seemed to languish.

But this lack of interest was seeming and not real, for during all the years of our existence as an associated body there has been a steady growth, though of a kind not always obvious to the looker on.

As I recall our position in years that are past, I see a time when a few members—not the less earnest because they were few—were struggling along, without a library worthy of the name, and with collections of objects for study, small in quantity, and so crowded together that you might touch them from the table where we gathered.

Now, as you may observe, the society has the use of a suite of rooms, and much better facilities in all its departments for carrying on its work. The library has been largely added to by the purchase of series of magazines necessary for the students in several departments of natural science, and quite lately we have added, by purchase from the Mechanics' Institute, a number of scientific books of more general interest.

There has also, for several years past, been a steady influx of donations to the museum from friends of the society, so that the members now have within reach books to read and materials to examine and study of much greater value than those available to the first members of the society.

I regret that of late there has been little opportunity for the members to pursue the study of natural history collectively in the field, and would suggest that the practice of holding field meetings should be revived. In such meetings, in some societies known to me, it is the practice to give prizes for collections made and named in the field—a practice which serves to give the younger members a greater interest in the proceedings.

Though we have not met for combined effort and mutual instruction in this way for some time, I observe that several of the members are pursuing individual work which has received commendation abroad. Among such I may name Dr. L. W. Bailey, Prof. W. F. Ganong, and our recording secretary, Mr. W. J. Wilson. Mr. Wilson's discovery of new types of insects and crustaceans in the plant beds of Lancaster is the subject of a paragraph in the proceedings of the Royal Society of Canada,* and is alluded to by Dr. S. H. Scudder,

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* See address of the President of Sec. IV., in 1889, p. 11.

Librarian of Harvard University, in his address to the Cambridge Entomological Club.*

In connection with this subject I would call your attention to the great progress which has been made in the last ten years in our knowledge of fossil insects, and especially those of the Palæozoic rocks, through the observations of Dr. Scudder, Alex. Brongniart, and a number of German investigators.

You are aware that naturalists divide the modern insects into seven orders. Three of these orders are regarded as belonging to a higher series than the others, as they undergo a more complete metamorphosis, and differ also in other respects. These higher orders we may consider to be represented by bees, the butterflies, and the two-winged flies. The remains of such insects are comparatively modern, for they have not been found in the Palæozoic rocks, though numbers are known from the Tertiary formations.

In the lower series, containing four orders, the metamorphosis of the individual is incomplete, and these have all been traced back to the Palæozoic formations. To these lower orders belong the Devonian insects of St. John, and the numerous insects found in the coal measures of Germany, England, Canada, and the United States.

Until recently only two of these lower orders were known in the Palæozoic rocks, but late discoveries have added the other two, so that now the whole four orders, which may be represented by the dragon-flies, the grasshoppers, the beetles, and the bugs, are found to have had representatives living at some time between the Silurian and Permian ages.

The greatest addition to our knowledge of these old insects has arisen from discoveries made at Mazon Creek, in Illinois, and at Commentry, in France. At the latter place have been found gigantic may-flies and "walking-sticks," besides great numbers of cockroaches and other insects. Six hundred specimens of insects have been found here, and are now being studied by Alexander Brongniart.

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* The Work of a Decade upon Fossil Insects, p. 288.

Great numbers of cockroaches have been found also in the American deposits, and Dr. Scudder has for this reason called the carboniferous period, so far as insects are concerned, the age of cockroaches.

On the other hand, no cockroaches have been found among the Devonian insect remains of St. John, for our insects, according to Dr. Scudder, are neuropteroid, or pseudoneuropteroid, only, or, in other words, are related to the dragon-flies and may-flies.

The St. John Devonian insect wings are now no longer the oldest indications of that class of animals known, for at Calvados, in France, there has been found a solitary wing of a cockroach in Silurian sandstone. This wing is not very well preserved, but so far as can be judged from the figures of it given in several publications, it is the wing of some insect similar to a cockroach.

The existence of wood-boring beetles in the carboniferous age had been inferred from the discovery of wood of that period which had been bored by larva, in a way similar to that of modern beetles. The actual wing-cases of beetles, however, have been lately found in the stone coal of Silesia, by Dr. Dathe.

Even the remains of bug-like insects have been recovered from the carboniferous rocks of Missouri, and from the Permian of Bohemia.

Thus we find that the whole four of the lower orders of insects, or at least forms out of which they sprang, were living in Palæozoic times; and the fact that one of our members has been able to add to the number of these rare and most interesting relics of the early denizens of the air, is creditable to his acute observation, and to the association of which he is a member, for such remains are not easily detected.

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I would now ask your attention to another point of local geology which it appears to me fitting to bring first before this society, as the foster-mother of scientific investigation in our community.

Many years have now elapsed since the discovery of Eozoon (the dawn-animal) and its description by Sir Wm. Dawson,[*] without any important associated fauna having been found.

It has been stated that the same, or a similar organism, has been found in various countries, as Bavaria, Ireland, and Massachusetts, but apparently Eozoon alone, and no other animal with it, and the animal itself in some of these cases very imperfectly or doubtfully preserved. It is true that Sir William records the occurrence at Côte St. Pierre of minute spherical bodies[†] in connection with Eozoon, but these he explains to be an open growth of Eozoon at the upper surface of an Eozoonal colony, and not an independent organism.

He also mentions the presence of a crystalline structure, such as is highly characteristic of crinoidal remains, when preserved in limestone. But we are informed that the more dense parts of Eozoon sometimes show this structure, though less distinctly. It is evident, therefore, that we cannot put much reliance on this structure as showing the presence of organisms other than Eozoon. The same remark applies to the observations of Sir William respecting the presence of minute grains simulating the forms of foraminiferous shells.

A more positive evidence of the presence of other creatures than Eozoon in the seas in which this animal lived, may be drawn from the perforations discovered in the limestone of Madoc, Ontario, which Sir William supposes may have been made by worms, having the habit of Scolithus (or Arenicolites).

Despite these observations, it is evident that very little positive evidence is known of the existence of creatures contemporary with Eozoon.

The nearly entire absence of other animal remains from the rocks containing Eozoon, and the fact that a stout fight has been made by certain English and German chemists in favor of its mineral origin, has caused many to doubt the animal nature of the object which goes under that name.

Among these doubters are many of the leading geologists of America. No better test of opinion on the subject could have been had, than that obtained by the circulation among the American geologists, by Dr. Fraser, as reporter on the Archæan rocks, to the International Congress of Geologists, of the question, "*Is Eozoon Canadense of organic origin*"? The replies to this question will be found in the September number (1888) of the "American Geologist," p. 175, where we find that among fourteen geologists consulted, if we leave out the two original investigators of Eozoon, Sir Wm. Dawson and Dr. Hunt, only one, on his own authority, pronounced Eozoon to be organic. This geologist is Mr. C. D. Walcott, of the United States Geological Survey. But probably a number of the others have not had the opportunity of studying Eozoon in the field.

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[*] Can. Nat., 2nd Ser., Vol. II., 1865.

[†] Called Archæospherina.

The mode of occurrence of Eozoon in the rocks in which it is found is such that one accustomed to observe the older organisms, resembling the reef-corals, can hardly come to any other conclusion than that Eozoon is of organic origin, and this irrespective of the evidence supplied by the microscope.

The outward appearance of Eozoon is so much like that of some stromatoporoid corals that if the object were found in Ordovician or Silurian rocks its organic nature would scarcely be questioned.

Admitting that Eozoon is of organic origin, it certainly is a remarkable fact that it is the only organism of its kind known; and still more remarkable that it stands almost alone as a solitary animal structure in the great system of rocks to which it pertains.

Remains of other animals have been sought for in these Eozoic rocks, but so far as I know without much success. Discoveries of pre-palæozoic fossils have from time to time been reported but many of these have afterwards been found to pertain to the Cambrian or Ordovician faunas, or are so obscure and indefinite that they are of little value in carrying back the history of life behind the Cambrian forms.

Often also the absence of a definite Cambrian horizon leaves the exact age of such reputed pre-Cambrian animals open to doubt. Such for a long time was the position of the Olenellus fauna, now found to begin at the base of the Cambrian. Such also is the status of the imperfect fauna discovered in the Catlinite or Indian pipestone beds of Minnesota. Of this it can as yet only be said, that it is older than the upper Cambrian.

For a similar reason a certain amount of doubt attaches to the exact age of the Monian system of rocks of Anglesea, described by Mr. Blake; for on that island the oldest fossiliferous horizon is Ordovician, or post-Cambrian. The Monian system is elaborately described by Mr. Blake, but as yet he has found no fossils in it; and in fact it appears to consist largely of altered sediments, where the fossils, if they ever existed, have been obliterated.

Mr. Walcott has found an obscure discinoid shell, and what he regards as the pleura of a trilobite in pre-Cambrian strata of the Rocky Mountain region, but this, it will be admitted, is but a very imperfect representation of a pre-Cambrian fauna. Anything therefore which goes to prove the existence of living beings prior to the Cambrian age is of considerable importance to the geologist, and to the naturalist as well; it is with pleasure, therefore, that I am able to call your attention to the existence in your neighborhood of remains of organic forms of an antiquity far antedating the Cambrian age.

As we have at Saint John a definite base to the Cambrian system, and since these basal rocks carry the very oldest Cambrian fauna known, we are sure of the greater antiquity of the organic forms to which I refer.

Not only is this antiquity shown by the nature of the fossils, and the entirely different lithological aspect of the series from the Cambrian system, as developed here; but the great denudation which the older system had suffered before the deposition of the Cambrian beds is shown by the occurrence of a conglomerate at the base of Division I. of the Cambrian, which is derived from the limestones of the older system.

Furthermore, between these two systems a third system of rocks — the Coldbrook (or Coldbrook and Coastal) — is interposed, which also has given conglomerates to the Cambrian, and which has a great thickness.

The oldest of these three series of rocks has been described in the reports of the geological survey of Canada as the "Upper series" of the Laurentian area, and in this the fossils I refer to have been found.

At three horizons in this system, remains of animals of low organization occur. The oldest is in the upper part of the quartzites which are found in the lower half of the system. They are Hexactinellid sponges, probably allied to the genus *Cyathospongia.* The frame-work consists of a somewhat irregular set of cross-bar spicules, forming a mesh, in the intervals of which are scattered smaller spicules similarly arranged.

The second horizon of organic forms is in the upper limestones of the "Upper series." The organism found here is of an entirely different character from the sponges. It is one of the calcareous coral-like structures, somewhat like certain forms found in the basal beds of the Cambrian. Its structure has not yet been studied, but it consists of elongated cylindrical objects with bodies from one inch to three inches across, and several inches in length.[*]

The object consists of a cumulative growth of conical partitions, layer upon layer; building up a cylindrical body that in cross-section looks not unlike a part of a tree trunk; and which bears a general resemblance to *Stromatopora rugosa.* The upper limestones at the base of which these organisms are found have probably suffered greatly from denudation, as we find areas of the rock system to which they belong, which do not appear to have the upper limestones. Good examples of the fossils are known from only one locality.

The third horizon is that of the graphite beds, in which occur great numbers of spicules of sponges arranged in parallel sets, one set crossing another at an acute angle. This type of sponge is apparently Monactinellid. As only straight needle-like spicules, without rays, have been observed in this sponge, it probably was a mass of jelly, or sarcode protected

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Arche [*] Described further on as ~~E~~*ozoon Acadiense.*

and sustained by the spicules which traversed it. A similar sponge was found in the fine black shales of Division I. Band *d*, of the St. John Group, at Musquash.

It seems doubtful if the system of rocks in which these three organisms have been found, is of exactly the same age as that which in the Province of Quebec has been found to contain Eozoon. Sir William Logan, who examined our limestones many years ago, thought them more recent than the Laurentian limestones of the Ottawa Valley. He found them less crystalline than those. There seems no reason, however, why the sponges which are so plentifully distributed in these Acadian limestones of the "Upper Series," should not be found also in that eozoonal limestones and associated deposits of the Ottawa Valley, as they appear to have had a wide range in early Cambrian and pre-Cambrian times.

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Lest I should weary you with the details of a subject which probably interests only a limited number, I now pass to another matter, which is of more immediate concern to the members of this society.

Perhaps the most important event to us in the past year is the acquisition of the museum of the Mechanics' Institute, including the Gesner collection.

Learning that the directors of the Institute were about to wind up its affairs, your council thought it advisable to apply to that body for the transfer of the trust of the Gesner museum and the purchase of the remainder of their museum. The directors of the Institute have accepted the offer of your council and the collections they held have now passed into your hands.

The Gesner collection, which forms the bulk of the Institute museum, will add greatly to the material available for the purposes of our society. Its ethnological collections contain many articles from Polynesia, China, the Indies and Australia, of which we had no counter-parts. Objects of this kind are useful for comparison with the rude implements, etc., of the existing Indian tribes of our country, and their predecessors.

The collection of minerals is a good one and contains fine examples of the Nova Scotian zeolites and quartz minerals, and will add many species to those which the society previously possessed. The general collection of fossils and rocks also has many European and United States examples which will serve to extend our series of such objects.

In the Gesner museum is the collection of rocks, minerals and fossils made by Dr. Gesner when employed on the Geological Survey of New Brunswick. These are of historical interest, and with them in hand the reader of Dr. Gesner's reports will be able to understand what he meant by the terms serpentine,* and grauwacke, trap and other obsolete terms of geological literature.

A good and useful piece of work for some member of this Society would be the study of this collection of Dr. Gesner's, to determine what are the modern names for his rocks. It should be remembered that Dr. Gesner's survey was made when geology was in its infancy, and was the first undertaken by a provincial government in Canada; or, so far as I know, in any British colony.

With the collections of this old survey, the society has acquired Dr. Gesner's geological map of New Brunswick, which never was published, but which is necessary to the full understanding of his reports.

In the Natural History part of the museum the society has received a considerable number of native mammals, which, though not all creditable as specimens of the taxidermist's art, are useful to show the wild animals of our country to those who cannot visit them in their native haunts.

Among the birds are a few groups of foreign birds which are a welcome addition to our museum and also some native species, but most of the native birds are duplicates of those already in the society's collection.

There are quite a number of reptiles and fishes, including some foreign species, and several small cases of European and Asiatic insects, some of them much faded, but the cases contain many peculiar insects, interesting from their large size, or remarkable form.

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* "Serpentine" is still used, but not in the sense in which Dr. Gesner employed it.

Among the lower invertebrates, a case of corals and other radiates will add to our means of instruction. A feature of the Mechanics' Institute Museum, which is included in the collections handed over to us, are models of improvements in ship-building and other arts which have flourished, or are still carried on among us.

By the assumption of the charge of this museum, the society has put itself under considerable pecuniary obligation, both for purchase and maintainance. It will be necessary to fit up and heat additional rooms, and further expense will be incurred for attendance, fuel, light, and insurance.

The arrangement of the Gesner collection, made some fifty years ago, is not at all up to modern ideas, and an entire revision and re-cataloguing of the museum is urgently called for. For all these calls, as well as the expense of moving, we hope that means will be provided. The council of the society in the purchase of this museum have been able to preserve to the city a collection which otherwise would have been dispersed, and would have passed into private hands, but we now hope may, for many years to come, be of public utility to the citizens of St. John.

## ARTICLE I.

# EOZOON AND OTHER LOW ORGANISMS IN LAURENTIAN ROCKS AT ST. JOHN.

BY G. F. MATTHEW, M. A., F. R. S. C.

(Read 7th October, 1890.)

One of the earlier results of the Geological Survey of Canada was the discovery and description of that lowly organism, *Eozoon Canadense*, a creature so obscure in its relations, and so far removed from any modern animal with which it may be compared, that it has formed the theme of controversy for more than a decade.

Outside of the earlier observations and studies on the subject, undertaken by Sir Wm. Logan, Sir Wm. Dawson, and Dr. Hunt, very little has been done by Canadians to add to the range of our knowledge of this interesting organism.

Sir Wm. Dawson has had to maintain almost single-handed, so far as America is concerned, the controversy in favor of the animal nature of Eozoon; while the opposition to his views has been strenuous, and has been carried on by several leading scientists both in Europe and America. So strong has been the objection taken to his explanation of the nature of Eozoon, that a large majority of the American geologists, whose opinion on this subject was sought, gave their verdict against it.

Any new observations on this subject, therefore, cannot but be of interest to all who give any attention to the historical branch of geology.

The earliest knowledge of the occurrence of Eozoon in the neighborhood of St. John was obtained many years ago, when the writer collected and forwarded to Sir Wm. Dawson, pieces of the limestone on the south side of Lily Lake containing serpentine. In this limestone Sir William found Eozoon in a fragmentary condition.

Sir William, in his work on Eozoon, Life's Dawn on Earth, p. 235, described the Canadian species as occurring in rounded masses, or thick, encrusted sheets, frequently of large dimensions. The typical structure was said to be stromatoporoid, or with concentric calcareous walls, frequently uniting together, etc., etc.

I have lately met with an article by Sir Wm. Dawson, (Geol. Mag., Lond., vol. V. of series III., Feb., 1888), in which he gives new facts on Eozoon, and modifies his description of the form of this fossil.

"1. *Form of Eozoon Canadense.*—Hitherto this has been regarded as altogether indefinite, and it is true that the specimens are often in great confluent masses, or sheets, the latter often distorted by the lateral pressure which the limestone has experienced. The form from Tudor, however, figured by Sir W. E. Logan (in Quart. Jour. Geol. Soc., Lond., 1866, p. 253, and described by me, * * * and figured by me in my work, Life's Dawn on Earth), gave the idea of a turbinate form, more or less broad. More recently additional specimens, weathered out of the limestone of Côte St. Pierre * * * compared with several less perfect specimens in our collections, have established the fact that the normal shape of young and isolated specimens of *E. Canadense* is a broadly turbinate, funnel shaped or top-shaped form; sometimes with a depression on the upper surface, giving it the appearance of the ordinary cup-shaped Mediterranean sponges. These specimens also show that there is no theca or outer coat either above or below; and that the laminæ pass outward without change to the margin of the form, where, however, they tend to coalesce by subdividing and bending together. The laminæ are thickest at the base of the inverted cone, and become thinner and closer on ascending, and at the top they become confounded into a general vesicular or acervuline layer. I now feel convinced that broken fragments of this upper surface, scattered over the sea-bottom, form those layers of *Archæospherinæ* which I at one time regarded as distinct organisms."

"It is to be observed, however, that other forms of Eozoon occur. More especially there are rounded or dome-shaped masses, that seem to have grown on ridges or protuberances, now usually represented by nuclei of pyroxine."

The above remarks may be considered to embody the result of Sir Wm. Dawson's matured studies on the form of *Eozoon Canadense,* and show very clearly its distinctness from the calcareous object I describe below. The broad top-shaped or funnel-shaped form of the Eozoon implies the possession of concave rather than convex partitions (laminæ); but hundreds of examples of the Acadian fossil show that the normal shape of its layers is convex.

Some months since the attention of the writer of this communication was called by Mr. Wm. Murdoch, C. E., of St. John, to the appearance of some fragments of crystalline limestone, which were thought to be pieces of petrified wood. The fragments had been broken from ledges, at a locality which from his knowledge of the local geology, the writer knew to be from the upper series of the Laurentian area near St. John, N. B.

These fragments had apparently a concretionary structure, but differed from any concretionary limestone the writer had seen before. The pieces exhibited were not sufficient to show the nature or origin of these apparent concretions, and an early opportunity was embraced of visiting the locality and making observations on the spot. This visit resulted in the discovery of an extensive reef of limestone, in which immense numbers of these peculiar fossils are preserved in a remarkably perfect condition.

The reef began its growth on a bottom of fine sand, now converted into a quartzite rock which forms an important member of the Upper Series. There the objects consist of a multitude of small, short, closely set columns, which grew tier upon tier, with at first more or less of sand between the tiers.

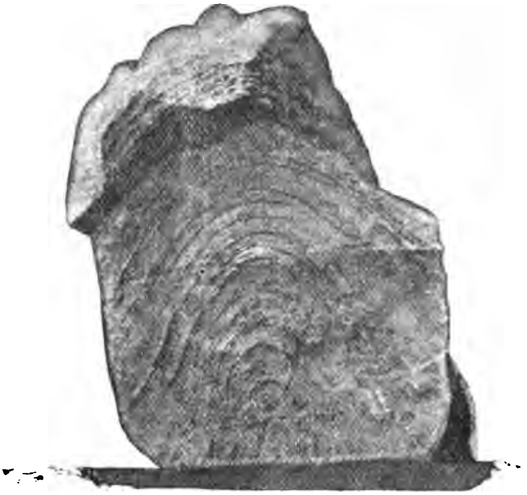
It may be observed also that these crowded clusters of columns were often cut off over considerable areas, by thin horizontal layers of mineral matter, perhaps indicative of the incursion of sand or other sediment, but the growth was almost immediately renewed by a new set of columns, occupying the fresh surface of mud that covered the old ones.

In the upper part of the reef in which the columns flourished and grew luxuriantly, it is very interesting to observe the apparent effort put forward by some of these columns to overtop their fellows. Those that grew most vigorously would spread and crowd the adjoining ones, so that they were compelled to elevate the centres of their calcareous layers. Thus in these crowded columns the layers became almost funnel-shaped, while in the broad ones that had plenty of room to grow they flattened out to a saucer shape, or in some cases are almost entirely flat. It is these funnel-shaped layers which, when they are cut across, have the appearance of the ends of sticks of wood. They have thus given to unpractised observers the impression that the rock consisted of crowded masses of wood turned to stone.

Sometimes one of these columns was quite crowded out of existence by its more vigorous neighbors. In other instances, we appear to have cases where the columns bifurcated, and formed two to occupy space otherwise vacant on the sea-bottom. Another feature of these columns which helped to carry out the deception that led those who first saw the rock to suppose that each column was a stick of wood, was that the silicious layers are thinner, and sometimes fail altogether at the centre of the column. As the spaces between the calcareous layers are filled up with mineral matter of a darker hue than the calcareous substance, the columns appear to have a dark centre like the pith of a tree; hence they were thought to be trunks of "hardwood" or exogenous trees.

This reef of calcareous columns was about one hundred and fifty feet deep, but its lateral extent is not known, as it is cut off on one side by a fault, and on the other passes beneath the waters of the St. John River, and thence probably beneath the lower carboniferous sandstones of the Kennebecasis valley.

A peculiarity of the calcareous column is that it is usually surrounded by a casing of more silicious matter. A space of a quarter of an inch, or more, may separate two of the columns, the space between being filled up with an irregular and broken calcareous deposit.



Problematical fossil from Laurentian limestone at St, John, N. B.
Side view of a portion of a column. Reduced ½ diam.*

The microscopic characters of these columns and their layers have not been studied, but to the naked eye the more silicious layers, when well preserved, are distinctly beaded as if they were the filled up chambers of an organism, in which the chambers were imperfectly separated from each other.

A peculiarity of this object is that of the sudden cessation of growth, either of part, or of the whole of an individual column. In a case of this kind the space thus left vacant, is occupied by the extension over it of the layers of a neighboring column or by the growth of one or more new individuals on the senile surface.

These new columns have in all cases a dome-shaped or hemispherical form, which they retain till they are as large or larger than a finger-end; after which the layers begin to flatten. Here we have on a small scale a form of growth similar to the larger dome-shaped masses of *Eozoon Canadense* described by Sir Wm. Dawson.

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* From a photograph by J. S. Climo.

There is a fossil described by Prof. James Hall (*cryptozoon proliferum*), occurring in the Calciferous rocks at Greenfield, N. Y.,[*] which at first glance strikingly resembles the Acadian fossil above described, but it differs in the mode of growth, as it occurs in rosettes of various sizes, consisting of concave laminæ.

Another organism which occurs in black silicious slate near Lily Lake, consists of black, linear, flat objects that appear to be of the nature of sea-weeds or graptolites, but which have not been found in specimens sufficiently complete to give a satisfactory indication of their relationship.

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[*] See 36th Ann. Rep. N. Y. State, Mus. Appendix.

## ARTICLE II.

## ON THE OCCURRENCE OF SPONGES IN LAURENTIAN ROCKS AT ST. JOHN, N. B.

BY G. F. MATTHEW, M.A., F.R.S.C.

(Read 3rd November, 1890.)

A year ago when visiting Drury's cove, an indentation of the Kennebecasis river, in company with members of this society, my attention was attracted by certain smooth surfaces in the layers of the quartzites at that place. These, by their appearance, recalled the shining surfaces of flags of the St. John group over which spicules of hexactinellid sponges are scattered. Fragments of this rock were submitted to the microscope and found to carry solitary spicules, and also fragments of the network of a sponge. The arrangement of the bars in these fragments of sponge skeleton would indicate a species resembling Cyathospongia. The following is a description of its character:

### CYATHOSPONGIA (?) EOZOICA. n. sp.

Skeleton of parallel and some forked spicules, crossed by other spicules at right angles, or nearly so. The spicules are of two sets of different sizes—one larger, forming a fenestral framework to the sponge; the other smaller, producing a minute network in the interspaces of the larger spicules. Spaces between the bars of the framework about one four-hundredth of an inch, the finer spicules are made visible by a one-fourth inch objective.

As only fragments of the skeleton of this sponge are known, the reference to Cyathospongia is conjectural.

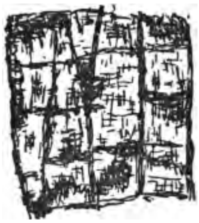

Fig. 1. *Cyathospongia eozoica.* Mag. 80 diam.

In the size of its mesh this sponge may be compared with fragments of hexactinellid sponges found in the basal (Etchimenian) series of the Cambrian rocks of this region. The mesh of the sponge is much smaller than that of *Protospongia fenestrata,* Salter, of the Welsh Cambrian rocks; it is also smaller than *P. minor* of Div. 1*d*, of the St. John Group.

*Horizon.* In the quartzites of the middle division of the upper series.

The great limestone beds of the upper division are present in force at Drury's cove and vicinity, and contain beds, some of which are bitumenous and others graphitic. On examining these limestones, graphitized layers were found whose surfaces exhibited numerous spicules of sponges. Finding the sponge remains particularly abundant on the graphitic layers, I was induced to examine the surfaces of the graphite, which is found in irregular beds in the upper part of the Laurentian rocks near the Falls of the St. John river. These graphite beds proved to be remarkably rich in sponge remains. So plentiful are the groups of spicules on the layers of the rock, that the individual form of the sponge could not be made out.

### HALICHONDRITES GRAPHITIFERUS. n. sp.

I did not detect Protospongia or Cyathospongia in the graphitic shales, but there are immense numbers of simple spicules; long, acerate, and mostly in parallel sets. The sets of spicules lie across each other at all angles.

So far I have been unable to determine whether this sponge, with bands of parallel acerate spicules, is a monactinellid or hexactinellid sponge, and therefore refer it to Sir Wm. Dawson's provisional genus *Halichondrites.*

*Horizon.* In graphitic slates in the lower half of the upper division.

Although the spicules observed on the graphitized layers often cross each other at acute angles, I have not observed such a constant relation of this kind as to lead to the supposition that any of these sponges belong to *Rhombodictya;* nor is there such a frequent flabellate arrangement of spicules as to suggest *Cyathospongia.* The arrangement of acerate spicules, as seen in *Askonema,* is somewhat akin to that of the species described above, but the Laurentian species shows much wider bands of spicules than *Askonema.*

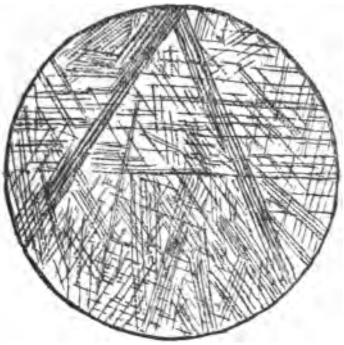

Fig. 2. *Halichondrites graphitiferus.* Mag. 12 diam.

Besides the bands of parallel acerate spicules, groups of closely crowded spicules occur, that may have been the anchoring bands of some pedicellate sponge.

On the smooth surfaces of other graphitic rocks the same forms of acerate sponge spicules were observed as are seen on those of the St. John mineral. Similar spicules occur also on the surfaces of black shales of Div. 1*d* of the St. John group at Musquash, N. B.

It may seem a remarkable thing that sponge spicules should be so plentiful in graphite. If unchanged they would certainly be an injurious constituent of a substance applied as a lubricant in the arts. I can only conjecture that the form is there, but not the substance. It is well known that the silica of sponge spicules is in a very unstable condition, and, therefore, very liable to chemical change. The silica of these spicules may have been replaced by some other mineral less harmful to a lubricant than that substance. Veins of quartz traverse the graphitic beds at St. John, in all directions.

### Systematic Position of the Sponges, Etc.

In the northern part of the city of St. John, below the Palæozoic rocks, there is an area occupied by gneisses, micaschists, quartzites, limestones, etc., which have been referred to the Laurentian system. The quartzites and limestones occupy basins in the gneiss and constitute an upper series. Three basins are known, two within the city limits and one to the northward of them, in Kennebecasis Bay. There are three principal sets of strata in these basins, viz.: Near the base schistose beds with limestones; in the middle quartzites and silicious slates; and towards the summit limestones with silicious and graphitic slates. This is the general succession, but further study is required to determine the parallelism of the several members in the different basins. The whole of these Laurentian rocks are separated from the Cambrian by a great mass of intermediate rocks usually denominated Huronian.

We thus have below the Cambrian rocks the following descending succession:

| | | | Thickness. |
|---|---|---|---|
| ARCHÆAN. | EOZOIC. | Coastal series (or system), 1872.—Grits, hydromicaschists, argillites, etc.; resembling the Pebidian rocks of Dr. H. Hicks, | 10,000 feet. |
| | | Coldbrook series (or system), 1865.—Diorites, felsites, petrosilex, etc.; resembling the Arvonian rocks of Dr. Hicks. Thickness more than.... ...................................... | 15,000 " * |
| | | Upper series (or system) of Laurentian, 1872. | |
| | | Upper division. Argillites, limestones, graphitic shales. *Fossils*. In upper part of the upper limestones of the South basin, fragmental *Eozoon*, observed by Sir J.W. Dawson in specimens sent him. In middle of upper limestones in Middle basin, spicules of sponges. In graphitic shale of South basin spicules of *Halichondrites graphitiferus*. In lowest limestone of the Middle basin, the reef of columnar fossils described in the preceding article (Article I.)............... | 740 " |
| | | Middle division. Quartzites, siliceous schists, *Fossils Cyathospongia* (?) *eozoica* near the top of this division,........... | 450 " |
| | — | Lower division. Limestones and gneisses. No Fossils known. | 260 " † |
| | | Lower series of Laurentian. Gneisses, Micaschists, etc.,..... | ? |

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* The above thicknesses are on the authority of Dr. L. W. Bailey. Report Progress Geological Survey Canada, 1879. pp. 10, D. D. and 21, D. D. Dr. R. W. Ells in the same Report, p. 6, D., describes these rocks, sixty miles east of St. John, as one system, with a thickness of 14,000 feet.

† Fuller descriptions of these rocks may be found in Rep. Prog. Geol. Surv. of Canada, 1872. pp. 30, 34, etc.

## ARTICLE III.

## ZOOLOGICAL NOTES.

BY W. F. GANONG.

Report of the Committee on Marine Invertebrate Zoology.]

## I. MOLLUSCA.

The numbers refer to the species in the writer's "Preliminary List of the Marine Mollusca of New Brunswick," published in Bulletin No. VI. (1887) of this Society. The typography also follows the rules of that list.

12*a*. BUCCINUM CINEREUM.—(Say), Gould.

UROSALPINX CINEREA.—St. (F).

This species is undoubtedly to be added to our list, though not actually reported from our coast. Verrill (F) reports it from southern part of the Gulf of St. Lawrence, and Dawson (Rep. on Geology of P. E. I.) from waters of Prince Edward Island. Probably it is not abundant.

[31*a*. NATICA PUSILLA.—Say.

Reported by Fuller (2nd. Rep. on Nat. Hist. and Geol. of Maine, 1862,) from St. Croix River in vicinity of Dochet, or St. Croix, Island. This is a southern species and its presence in our waters needs confirmation. Possibly was confounded with *L. Grœnlandica.*]

35. LUNATIA TRISERIATA.—Say.

Almost beyond question a color variety of *L. heros.* See Verrill, Am. Jour. Sci., iii., III., 1872, p. 282.

43*a*. ODOSTOMIA SEMINUDA.—(Adams), Gould.

Reported by Rev. H. W. Winkley, in Bull. No. VII., 1888. The present writer has specimens which are undoubtedly of this species, taken from the mud of oyster-barrrels which came from the Gulf of St. Lawrence. Though not actually reported from our own coast, it must occur there. Being a southern species its occurrence in the Gulf is of special interest. The specimen of this, as well as of the following (43*b*, 43*c*), are smaller than the southern specimens, if the measurements in Binney's Gould represent the average size.

43*b*. ODOSTOMIA BISUTURALIS.—(Say), Gould.

[See remarks under 43*a*.]

43*c*. BITTIUM GREENII.—(Adams), H. and A. Adams.

CERITHIOPSIS GREENII.—Verrill (F).

[See remarks under 43*a*.]

47. TURRITELLA COSTULATA.—Mighels and Adams.

Synonyms of this species are *Acirsa Eschrichtii*, *Acirsa borealis*,—both reported from Eastport.

53. LITTORINA LITOREA.—(Linn.), Forbes and Hanley.

Bathurst, 1885, *E. S. Morse.* (Bull. Essex Inst. XII., 1880, p. 176). First found on our Bay of Fundy coast at Gardner's Creek, near St. John, 1861 or 1862, by Mr. G. F. Matthew.

58. Omit the three notes which, by an error of the printer, are a repetition of those belonging to Nos. 147, 162 and 167.

77. After "Dalhousie" insert "one specimen."

79. TECTURA ALVEUS.—(Conrad), Stimpson.

"Not found on the southern coast" is found to be a mistake. We find it very abundant on eel-grass at low water at Grand Harbor, Grand Manan, and it probably occurs elsewhere in similar situations.

80. TECTURA TESTUDINALIS.—(Müller), Gould.

The shells of this species are called "Baby-shells" by the fishermen of Grand Manan from the semblance which the *animal* presents to a child covered all but the head, in a cradle. They are also called "cleavers," because they "cleave" to the rocks.

101*a*. UTRICULUS CANALICULATUS.—(Say), Stimpson.

[See remarks under 43*a*].

109. PECTEN TENUICOSTATUS.—Mighels and Adams.

Additional localities are given in Bulletin No. VIII, p. 64.

110. CRENELLA GLANDULA.— (Totten), H. and A. Adams.

In tide-pool at the head of the passage between Grand Manan and Ross Island, this species is found living in the greatest profusion, attached by a byssus to a bottom of fine gravel and shells. The tide-pools are left for several hours and become very warm.

113*a*. MODIOLA PLICATULA.—Lamarck.

Though not actually recorded from our own coast, it must surely occur there. Verrill (F), reports it from the southern part of the Gulf of St. Lawrence, and it occurs upon the north shore of Nova Scotia, about Picton, etc. It is not improbable that it may be found about the marshes at the head of the Bay of Fundy.

134. CYTHEREA CONVEXA.—Say.

Found by the writer at Oak Bay, Charlotte County, N. B., in 1889. Few dead shells only.

139. ASTARTE LENS.

A. CREBRICOSTATA.—Gould. (Verrill, Am. Jour. Sci. iii., III., 1872, pp. 213 and 287).

Two small specimens. Oak Bay, Charlotte Co., N. B.

141. TELLINA TENERA.—Say.

Omit "Off Douglastown," etc. This Douglastown is in Gaspé.

147*a*. TURTONIA MINUTA.—(O. Fabr.), St.

TURTONIA NITIDA.—Verrill.

Has not hitherto been reported from our waters. It occurs in considerable numbers about Grand Manan, though we regret to say we have not noticed in what particular habitat.

148*a*. CUMMINGIA TELLINOIDES.—Conrad.

[See remarks under 43*a*.]

155. COCHLODESMA LEANUM.—(Conrad), Couthouy.

Omit "Near Douglastown," etc., as in No. 141.

165. ZIRFAEA CRISPATA.—(Lin.), Adams.

L'Etang Harbor, near Sturgeon Cove, 4 dead valves. *W. F. G.*

168. XYLOPHAGA DORSALIS.—(Turton), Forbes and Hanley.

New Brunswick waters. See Bulletin No. VIII., p. 116.

## II. ECHINODERMATA.

The numbers refer to the species in the writer's "Echinodermata of New Brunswick," published in Bulletin No. VII. (1888) of this Society. The typography also follows the rules of that list.

8. **Asterias vulgaris**, STIMPSON, Ms.

ECONOMICS. The only direct value of the species to man consists, as stated, of its very limited use as a fertilizer. Yet the large amount of lime in its skeleton, and the rapidity with which the soft parts decay and allow it to fall to pieces and be more easily scattered, should make it of some value for this purpose where it can be obtained in abundance. In the United States, where they do such damage to oyster-beds that they must be systematically dredged, those thus taken are used for manure, though I cannot find that they are ever taken specially for this purpose. In England, however, the case is different. In Vol. II. of Sect. V., p. 622, of Fishery Industries of the United States (a splendid publication of the United States Government) is a quotation which states "Mussels and star-fish (five-fingers) have long been an established manure in the neighborhood of Faversham, Kent, They are procured by dredging. The mussels sell at 16s. sterling per wagon, and the five-fingers at 21s." Forbes (History of British Starfishes, p. 89,) writes: "A gardener told me that he would desire no richer manure than starfishes for his garden." They are said to be esteemed in France as a manure for grape-vines. If they are as valuable as this in Europe, our farmers should given them a trial. We know of places in Charlotte County where a wagon could be filled at a single low tide.

On the other hand, it is said by Mr. Ingersoll (Oyster Industry, U. S. 10th Census, p. 230) that the several attempts at oyster-culture in the region of Passamaquody Bay have failed on account of the rapacity of the hordes of great starfishes in the vicinity. We doubt very much whether oyster culture could be successful there, even if no starfishes were present, the conditions of temperature in summer being unfavorable to it. On our north shore, the starfishes are thought to do very little damage to the oyster-beds. (Bulletin No. VIII., p. 61).

It is not unlikely that the individuals of this species are poisonous, not indeed when taken into the hand, as many persons believe, but when taken internally or into the blood through a break in the skin. Indeed the latter appears to be proven, as is shown by a short article in the Bulletin U. S. Fish Commission, VII., 1887, p. 34. It is entitled, "Fatal injury inflicted by a starfish;" and describes the case of a fisherman whose hand, pierced between two fingers by a spine of a starfish he was removing from his hook, festered and swelled; blood poisoning ensued and the man died. It has been asserted also that starfishes from stagnant water are poisonous. (Zoological Record, XXIII., Mollusca, p. 45.)

The very bright and conspicuous coloration of many individuals of this and allied species, making them so easily visible to hosts of hungry enemies, offers strong presumptive evidence that they have some means of protection analagous to those of land animals which are conspicuously colored. In the latter case, particularly among the insects and certain reptiles, conspicuous colors are associated with disagreeable or poisonous secretions or juices, and the colors in such cases are of the nature of warning or danger signals. It seems reasonable to suppose that similar disagreeable or poisonous secretions may be associated with the bright colors of our starfishes. *Solaster endeca,* a brightly colored form, is known to be poisonous (see under this species below.) Græffe (Arb. Z. Quest. Wein., iii., pp. 333–344) says that large starfishes have a disagreeable smell, which, he thinks, aids in their protection. Whatever may be the reason, it is certain that fishes very rarely or never eat them, for they are not found in fishes' stomachs. This is not because they contain little nourishment, for the much less nourishing Cake-urchins (*Echinarachnius*), and Ophiurans, (*Ophiopholis*), are often greedily taken. It is a strong confirmation of our view as to the colors of the starfishes, that the forms mentioned, which are eaten, are more or less protectively colored. It must also be taken into account that the color of the sexes are different, which makes the problem more difficult of solution.

Forbes (Hist. British Starfishes) suggests that it may be an acrid or poisonous secretion which enables the starfish to compel bivalves to open their shells. Certainly the valves are not broken, and we apparently know as little as Forbes did of the starfishes' method of procedure, and we must repeat his remark that the question should be investigated.

SIZE. This species in the Bay of Fundy grows to a diameter of, at least, fifteen or sixteen inches. *A. rubens,* which is probably identical with it, is said to attain twenty inches in Europe. The statement in Ingersoll's "Oyster Industry," (p. 227), that near Eastport they occur more than thirty-three inches in diameter, is, of course, an error.

TERATOLOGY. Many monstrosities occur in this species. The most common is that in which six rays are found, and we have every variation from cases in which there are five rays, one of which is bifurcated at tip, down through different degrees of division of the split limb to cases in which there are six perfect rays. This shows one way in which the six-rayed state is brought about. But others are found, it is said (the present writer has noticed none), in which with six, or sometimes even more rays, are found two madreporic plates (or one formed by fusion of two), and two stone canals. Such cases are considered by Giard to be true double monsters, comparable with double fishes and the like. The subject is discussed in *Annals and Mag. Nat. Hist.*, 5th ser., I., 1878, pp. 259–260, translated from *Comptes Rendus* of Nov. 19, 1877, p. 973.

Again, in *Mag. Nat. Hist.*, 2nd ser., IV., 1846, p. 34, J Couch describes an *Asterias glaciális*, now considered to be *A. rubens*, which had eight rays and three madreporic plates. It is not impossible that it may have been a triple monster, the result of fission or budding in a single ovum.

The numerous cases in which there are four, three, two or even but one ray present are not ordinarily monstrosities, but the result of accident, and inspection will usually show that the missing rays are being replaced. A case is on record (Proc. Nat. Hist. Soc. of Glasgow, I., p. 41) in which one of the limbs growing to replace a lost one, was bifurcated. Yet cases of four and three rays would be monstrosities when these are the maximum number that the individual has had in its development. Such cases are likely to be confounded with those in which a limb has been recently lost, and are, therefore, likely to escape notice. Yet, such probably do occur in the true starfishes, as they certainly do in the Ophiurans, in which, on account of the inflexibility of the disk, the true number of arms is easily counted. The writer has a fine specimen of *Ophioglypha Sarsii* with four rays, which are placed at exactly equal intervals around the disk. There is a difference also, it may be said in passing, in the method of proceeding to repair a damaged arm, between the true starfishes and Ophiurans. The former throw off the injured member *in toto* from the base, while the latter begin at the first uninjured joint and grow the new arm from its extremity. The writer has specimens of *Ophiopholis aculeata* which illustrate this.

The true anatomical nature of the bifurcating processes referred to above has not yet been worked out. Usually the ambulacral and adambulacral plates are closely involved, but in other cases, the new limbs start from the abactinal surface without reference at first to the actinal surface. A rough classification of the monstrosities the writer has noticed, might be made as follows:

### *a.* MONSTROSITIES, EITHER OF INCREASE OR DIMINUTION OF PARTS, HAVING THEIR ORIGIN BEFORE THE FORMATION OF THE CALCAREOUS SKELETON, *i. e*, IN THE OVUM OR GASTRULA.

I. *Double and triple monsters.* Such, so far as known, are the result of fission, or budding in a single ovum; never the result of the union of two or three ova.

II. *Four or three-rayed forms which are not the result of a loss of a ray or rays, and six-rayed forms which are not the result of fission nor double monsters.* We do not know *positively* of any of these forms in the true starfishes, but the fact that a truly four-rayed Ophiuran (as the *Ophioglypha Sarsii*, referred to above) is found, renders it possible that truly three, four, or six-rayed starfishes may occur, though, as mentioned above, it would be difficult to distinguish them without careful examination. The only explanation for such a case as that of the four-rayed Ophiuran seems to be that the loss of the fifth arm dates from the first appearance of the calcareous plates.

### *b.* MONSTROSITIES, OF INCREASE OF PARTS, WHICH ARE THE RESULT OF BIFURCATION OR BUDDING IN THE SKELETAL SYSTEM.

I. *Six or seven-rayed forms which are the result of the fission to the base of one or two of the ordinary rays.* Occasionally the two rays resulting from the fission from one are not so large as their neighbors. The writer has seen (and possesses), a number of instances of this class, and believes there is a specimen in the society's cabinet.

II. *Forms having bifurcated and laterally branched rays, all of the systems of skeletal plates being involved.* These are the most common monstrosities. The bifurcation may be of any degree from the merest forking at the tip, down to nearly complete division, when it produces the condition of section *b*, I. The branching may take place anywhere along the arm. Instances of this were figured as early as 1733 by Linck (Dr. Stellis Marinis, Pls. XXXIV., XXXV., No. 58) in this or an allied species. A curious modification of this branching is seen in a specimen in the collection of Mr. Van Vleck, of Boston, in which the new arm starting from the under side of the parent near its tip, soon outgrew the latter. As a result the tip of the original ray was forced up so as seemingly (and really, too, for that matter) to project from the upper surface of the new one.

III. *Forms having new arms sprouting from the abactinal or upper surface.* Such cases are not uncommon, and the new ray may grow to a considerable size. Linck's specimen, referred to above, shows this, in addition to the other form of branching. A specimen in the student's collection in the Museum of Comparative Zoology, Cambridge, well illustrates this.

### *c.* MONSTOSITIES WHICH ARE THE RESULT OF FUSION OF PARTS.

I. We have seen but one instance of this, a specimen in the collection of Mr. Van Vleck in which two arms are distinctly united throughout their length, showing two separate ambulacral furrows with a line of adambulacral plates and spines between.

### *8a.* **Asterias Forbesii**, VERRILL.

We are very glad to be able to add this species to our fauna. It was inserted doubtfully in our list of 1888 on the chance that it might be found in the Gulf of St. Lawrence. We are still of opinion that it will be found there; but it has lately been discovered in a quite unexpected quarter. In September, 1888, the present writer found a specimen on Dochet Island, St. Croix River, and later found several specimens on the shores of the large island in Oak Bay, a few miles above. During September, 1889, other specimens were found near the latter locality, where it seems to be quite abundant. The specimens were four or five inches in diameter, which is the full average size of the species, and occur at low-water mark, in company with great numbers of the common and generally much larger *Asterias vulgaris.* There is no doubt of the identity of the species; for a specimen from Oak Bay sent to Prof. Verrill, the highest authority on American littoral starfishes, has been pronounced by him "a typical example of *A. Forbesii.*"

There are two explanations of the presence of this decidedly southern form in the Bay. One, suggested by Prof. Verrill, is, that it may have been brought with southern oysters and placed there with them. Oysters have been placed in Oak Bay, though I have not been able to learn whether southern or Gulf of St. Lawrence stock was used. In either case, it seems difficult to believe that starfishes could be carried so far out of water and survive. They have no method of retaining water as oysters have. Still the very young may have survived in the wet mud.

The other explanation is that they are a remnant of the southern or Virginian assemblage of animals which once occupied our entire Acadian coast. Oak Bay is a sheltered locality, not deep, but with clear water. The temperature of its water is high enough in summer to allow of bathing in comfort, which the water of the Bay of Fundy is not; and in this comparatively favorable locality this species may have survived all its southern comrades. No other southern species have been found in Oak Bay, though some search has been made for them.

9. **Asterias littoralis.** (STIMPSON), VERRILL.

A specimen of this species was given to the writer at Grand Manan in August, 1888, by Mr. Simon Cheney, the color of which can be described only by calling it an intense Prussian blue. Others, to whom it was shown, agreed that this was the proper name for its color. It was of the usual size of the species.

13. **Crossaster papposus,** (FABRICIUS), MÜLLER AND TROSCHEL.

Called by fishermen of Grand Manan, "Compass Star." (J. W. Fewkes).

14. **Solaster endeca,** (GMELIN), FORBES.

ECONOMICS. A case is on record which shows that this species may be very poisonous to animals. In the "Zoologist" for 1881, pp. 214, 215, we are told of a collector who placed a specimen before his study fire to dry. After it had been lying there for two days, two pet cats entered the room and ate it. One of them died within fifteen minutes, and the other in violent convulsions within two hours. The stomachs showed no congestion, which seems to prove that the poison acts on the cerebro-spinal system. It is well for our collectors to know such facts as this.

Specimens of *Solaster* are said to have been found with only six rays. (Proc. Nat. Hist. Soc. Glasgow, I., p. 37).

15. **Hippasteria phrygiania,** (PARELIUS), GRAY.

Two specimen were taken off Duck Island in 1889 by Dr. J. W. Fewkes. In the Museum of the Boston Society of Natural History is a fine specimen from off "Head Harbor, Me.," meaning, doubtless, Head Harbor, Campobello.

18. **Pteraster militaris,** (O. F. MÜLLER), MÜLLER AND TROSCHEL.

The best locality in the Bay of Fundy region for this species appears to be the vicinity of Razor Island, near Eastport. Dr. Fewkes took eight specimens there during last summer.

19. **Strongylocentrotus dröbachiensis,** (MÜLLER), A. AGASSIZ.

The common sea-urchin is said to bore holes the size of a six-pence in mussel shells. Mr. C. W. Harding (Fisheries Exhibition Literature, VI., p. 306) says that he has seen three instances of this. It needs confirmation in our waters before we can accept it.

This species is variable not only in form, but in the length and color of its spines. A very long-spined variety is common off Cheyne Island, Grand Manan, in 20 or 30 fathoms, and white-spined and red-spined forms also occur.

It was stated in our paper on this species in Bulletin No. VII., that it never excavates hollows in the rocks, as some other species are known to do. This is a mistake; for, during last summer, Dr. J. W. Fewkes found them in burrows which they formed in the soft rocks of the Black Ledges, a few miles from Nantucket Island, Grand Manan. He has given a brief description of them in the "American Naturalist" for August, 1889, and a more detailed account, illustrated by cuts made from photographs, appeared in the same journal in the January, 1890, number.

ECONOMICS. We find that this species has been used for food much more extensively than we were aware of when our account of the species was published in the Society's Bulletin in 1888.

It is quite probable that it was an important article of food to the Acadian Indians in the olden times. Such is the opinion of Prof. S. F. Baird, who found sea-urchin spines and shells in great abundance in a shell-heap at Oak Bay. (Proc. U. S. Nat. Mus. IV., 1881, p. 292). Mr. Matthew, in his study of a Bocabec shell-heap found its remains much less abundant, (Bull. this Society No. III., p. 24).

Lescarbot, writing in 1609, appear to have thought it good eating, for he refers to it under the name of Sea-chesnut (chatagne-de-mer), and declares it "a fish the most delicious that it is possible to be." Probably, as in France, he ate only the ovaries, if he ate it at all.

It is still eaten by the natives of Alaska and some of the Aleutian Islands; and Mr. H. W. Elliott (Seal Islands of Alaska, U. S. 10th Census, p. 137) describes the eager search made for it by the natives, who greatly esteem it. In Newfoundland, Jukes said in 1842 (Excursions in Newfoundland) it was used as food by many of the French, and Rev. Philip Tocque, in 1878 (Newfoundland, p. 497) wrote: "The sea-urchin . . . usually called in Newfoundland ox-eggs, . . . are frequently eaten in Newfoundland."

Our sea-urchin's habits, living, as it often does, on decaying fish and other offal, are not pleasant to contemplate from a gastronomical point of view, but it is well to know that it can be safely eaten if necessity demands. The ovaries, easily recognized by their granular appearance and orange color, are the only parts that should be used.

A complete discussion of the economics of our sea-urchin must also include its services to man as a scavenger, removing as it does, considerable quantities of fish-offal and the like. Another indirect use to man is found in its serving as food for fishes, some of which eat considerable numbers of it.

27*a*. **Molpadia turgida,** VERRILL. Am. J. Sci., iii., XVII., p. 473. Trochostoma turgidum, THIEL, Challenger Zoology. XIV, 1876, p.

Massachusetts Bay to Gulf of St. Lawrence. Bay of Fundy, VERRILL, *op. cit.* Given from "Gulf of St. Lawrence, WHITEAVES;" though we do not find it referred to in Whiteaves' writings.

29. **Chirodota tigillum,** SELENKA.
*Zeitschrift* für Wissenschaftliche Zoologie, [Leipzig] Vol. XVII., 1867, p.

"The twelve short tentacles bear 10-12 plumes. The calcareous wheels having five or six spokes, are entirely smooth, and measure 0.1 mm. in diameter; their rims are very small. The excrescences stand on the intermuscular spaces, always in a row. Animal colorless. The intestine winds in a knot. The calcareous ring is small, of twelve squarish pieces united. Polian vesicles hang to the number of ten or twelve around the ring-canal. Stone canal very small. Eastport, (Maine)."

## III. HYDROZOA.

**Physalia Arethusa,** Til. "Portuguese Man-of-War."

An entirely unexpected addition to our fauna. Dr. J. W. Fewkes, of Boston, who spent August and September of 1889 in study at Grand Manan, saw several specimens of this well-known southern jelly-fish "inside the Ripplings" near Grand Manan. He heard also of others seen by the fishermen, which, together with those he himself saw, made ten specimens in all. *Physalia* is common in the Gulf Stream, and is often blown on the south coast of New England, but its occurrence in our icy waters must be very rare. (*American Naturalist,* Vol. XXIII., p. 821).

It has been seen, however, still farther north — on the coast of Newfoundland. Rev. Philip Tocque ("Newfoundland," 1878) tells us: "The Portuguese men-of-war (*Physalia*) are sometimes seen on the coast;" the same writer in another work ("Solitary Thoughts") again mentions its presence in Newfoundland in a way which convinces us that he was not mistaken as to its identity. The Gulf Stream passes over a part of the Grand Bank, bringing these animals quite near Newfoundland, and southeasterly winds might drive them on the coast.

**Corymorpha pendula,** Ag.

This common tubularian hydroid was found by the writer in September, 1889, in a rather remarkable position. At a very low tide, great clusters of the species were found clinging to the woodwork of a weir on Rodger's Island, Oak Bay, Charlotte County. The tide had left some of them four or five feet above the water, and a collapsed and sorry-looking lot they were. They were exceedingly abundant, the posts in places appearing quite red over large patches.

# APPENDIX.

## REPORT OF THE COUNCIL OF THE NATURAL HISTORY SOCIETY OF NEW BRUNSWICK FOR THE YEAR ENDING JANUARY 20, 1890.

The Council of the Natural History Society desires to lay before the members a summary of the work done during the past year.

### MEMBERSHIP.

There has been no material change in the membership.

### FINANCE.

The Treasurer's Report shows the following receipts and expenditures:

| | |
|---|---|
| Balance on hand from last year | $224 53 |
| Receipts from dues | 94 00 |
| Provincial Grant, $125; Botsford Estate Inst., $175, | 300 00 |
| Bulletins sold | 10 00 |
| | $628 53 |
| Expenditure for the year | $378 49 |
| Balance on hand | $250 04 |

The whole of this balance will be required to pay for the Mechanics' Institute Museum and its its removal to our rooms.

Seven regular meetings were held, at which the following papers were read:

| | |
|---|---|
| FEB. 5th, 1889. | Geology with experiments —By G. F. Matthew, M. A. |
| MAR. " " | Economical Mollusca of Acadia. — By W. F. Ganong, M. A. |
| APR. 2nd, " | Notes on the Watershed between New Brunswick and Quebec.—By Dr. L. W. Bailey. |
| MAY 7th, " | Plant Life, with experiments.—By G. U. Hay, Ph. B. |
| NOV. 5th, " | A Sketch of the Life of Prof. Chas. Fred Hartt.—By Geo. F. Matthew, M. A. |
| DEC. 3rd, " | India Rubber and its Uses in the Arts.—By James A. Estey. |
| JAN. 7th, 1890. | The Growth of our Knowledge of the Invertebrates of Acadia and Newfoundland. — By W. F. Ganong, M. A. |

Besides these, classes in Chemistry, Geology, Zoology and Botany were very successfully carried on during the past winter of 1889, and a somewhat similar course is arranged for the present winter.

### LIBRARY.

The usual additions to the Library have been made in the way of exchanges for our BULLETIN, and a number of valuable scientific works were obtained at the sale of the Mechanics' Institute Library. Much work remains to be done to put the Library in proper order, and it is hoped that during the incoming year some of the improvements suggested in the last report will be made.

### MUSEUM.

Much that is valuable has been added from time to time to our collections, but by far the most important addition in late years is that obtained by purchase from the Mechanics' Institute directors. Of the importance of this acquisition the Council will not now speak, as the President will refer to it in his address; but before leaving the subject your Council would state that it will entail considerable expense on the society, and would bespeak the sympathy of the members, as well as the citizens generally, in its endeavor to preserve to the city a collection of so much interest and importance.

### BOTANY.

The Botanical Committee report that several species of plants new to the Province have been discovered, chiefly by Mr. Brittain, in the vicinity of Fredericton. The flora of certain sections of the Province has now been pretty thoroughly studied for new and rare species, but many other sections, embracing by far the larger portion of the Province, remains to be examined with minuteness and care.

### BULLETIN.

BULLETIN No. VIII. was issued during the summer, and was sent to members and various societies on our exchange list. This BULLETIN contains an article of great value, giving as it does, much valuable information on the economical Mollusca of our Province.

In closing, the Council would take this opportunity of thanking those who have prepared papers for us, and to all others who have aided us in our work. Also to the daily press of the city for inserting preliminary notices of meetings.

Respectfully submitted.

W. J. WILSON, *Secretary to Council.*

# DONATIONS TO THE MUSEUM.

| DATE. | DONOR'S NAME AND DESCRIPTION OF ARTICLE. |
|---|---|
| 1889.<br>Mar. | JOS. ALLISON.—Set of glass shades and stands. |
| Apr. | G. F. MATTHEW.—Laurentian limestone bleached by intrusive trap, Drury's Cove. |
| May | G. STEAD.— Slab with large ripple marks, Courtenay Bay. |
| | G. F. MATTHEW.— Slab with small worm-burrows (*Arenicolites brevis*), Cambrian, Courtenay Bay. |
| | J. BAXTER, M. D.— Caddis worm, Chatham; sponge, Miramichi Bay; walrus tooth, field at Tabusintac; piece of skin of negro, tanned. |
| Dec. | W. F. BEST.—Young of Sturgeon (*Acipenser*); Little brown bat (*Vespertilio subulatus*). |
| | MR. GILMOUR, Quaco.—Samples of raw cotton. |
| | PERCY HALL.—Honeycombed vein in clay slate. |
| | JAS. A. ESTEY.—India rubber, crude and in various processes of manufacture. |
| 1890.<br>Jan. | MARSHALL REED.—Fossil fern (*Archæopteris*), and two fossil fishes (*Pterichthys Canadensis* and *Phaneropleuron curtum* (?) from Devonian rocks near Dalhousie, N. B. |

# DONATIONS TO THE LIBRARY.

| Date. | Donor's Name and Description of Book. |
|---|---|
| 1889.<br>Mar. | M. Chamberlain.—Two Monographs on the Natural History of Alaska. |
| Apr. | Academy of Natural Sciences, Philada.—Proceedings, Part III. 1888; (Sept.), Part I; (Dec.) Part II. 1889. |
| | Naturhistorischen Hof Museum, Vienna.—Annalen, Band IV. No. 1 and separate part [1888. |
| | Education Office, Fredericton.—Annual Report of Schools, |
| | G. H. Wallace, Sussex, N. B.—American Naturalist, 3 vols., 1883–5 [Brunswick. |
| | Dr. D. Honeyman, Halifax.—Geological Recreations in New |
| May. | Washburn College.—Proceedings of, Laboratory of Natural History, Nos. 1–9. |
| | Author.—Glaciation of Eastern Canada, by R. Chalmers. |
| | Author.—Eozöic and Palæozoic Rocks of Canada, by Sir J. W. Dawson. |
| | Linnæan Society, New York.—Abstract of Proceedings. |
| | E. Gilpin, C. E., Halifax.—Quarterly Journal of Geological Society, London, May, Sept. Aug., 1889. |
| | N. Y. Microscopical Society, New York.—Journal, Vol. V. No. 2; (Sept.) No. 3; (Nov.) No. 4. |
| | E. Gilpin, C. E., Halifax.—Report of the Department of Mines, Nova Scotia, for 1888. |
| | Ottawa Field Naturalists' Club, Ottawa.—Transactions Vol. II., No. 12, Vol. III., No. 1; (Sept.) No. 2; (Dec.) No. 3. |
| | Feuille des jeunes naturalistes, Paris.—Catalogue of Library, Part V., Proceedings of, Apr., May; (Sept.), 225 and 226, (Oct.), 227 and 228. (Dec.), 230. |
| | Societe Malocologique de Belgique, Brussels.—(Oct.) Vol. XVII. Jan.–June, '89, Vol XVIII. [Report. |
| | U. S. Geological Survey Washington.—Seventh Annual |
| | G. F. Matthew.—American Journal Science, 1883 to 1888. |
| | U. S. Fish Commissioner, Washington.—Fishery Industry of United States. Sec. III and IV, Sec. V 2 vols. and plates. [vol. II. |
| | G. F. Matthew.—Royal Society of Canada, Proceedings, |
| | Heningway's Archæological Expedition.—The Old New World. |

DONATIONS TO THE LIBRARY.—(*Continued*).

| DATE. | DONOR'S NAME AND TITLE OF BOOK. |
|---|---|
| 1889.<br>May. | NATURAL HISTORY SOCIETY, Montreal.—Canadian Record of Science, vol. III , No. 6. |
| | LITERARY AND HISTORICAL SOCIETY, Quebec.—No. 19. |
| | N. H. WINCHELL, Minneapolis.—Geol. and Nat. History Survey of Minnesota. |
| | CANADIAN INSTITUTE, Toronto.—Proceedings, vol. VI, No. 2; (Dec.) vol. VII. No. 1, Annual Report, 1888. |
| | R. P. STARR, ESQ.—Acadian Geology. |
| June. | ROYAL UNIVERSITY, Christiania, Norway.—Die Silurischen Etagen 2 and 3, by W. C. Brögger; Silurfossiler, by H. H. Reusch; Forhandlinger, Scand. Natur, 13, part. |
| | AMERICAN MUSEUM NATURAL HISTORY, New York.—Bulletin, vol. II., No. 2, and Annual Report, 1888–9. |
| | BELFAST NATURALISTS' FIELD CLUB.—Annual Report, 1887-8 (Nov.) Proceedings. Series II., vol. III., Part I. |
| | NEW ENGLAND HISTORICAL AND GENEOLOGICAL SOCIETY.—Proceedings, Jan., 1889. |
| Sept. | GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA.—Annual Reports, 1874–5, 1875–6, 1882–3–4, and maps, 1885 and maps—Canadian Organic Remains Decades I., II., III. and IV.—Palæozic Fossils, Vol. II., part I.—Mesozoic Fossils, Vol. I., part I and II.—Fossil plants of Devonian and Silurian—Fossil plants of Lower Carboniferous—Report on Queen Charlotte Island—Chemical contributions—Summary Reports 1886 and 1888 Catalogue of Canadian plants, Part III.—Geological Map of Cape Breton—Geological Map of New Brunswick and Prince Edward Island. |
| | ROYAL SOCIETY OF CANADA.—Proceedings and Transactions. Vols. IV., V. and VI. |
| | SMITHSONIAN INSTITUTION, Washington.—Report, 1886, Part I. |
| | COLORADO SCIENTIFIC SOCIETY, Denver.—Proceedings, Vol. III, Part I. |
| | DR. R. W. SHUFELDT, Washington.—Morphology of *Gallus bankiva*—On the Muscles of Birds—On the Anatomy of Certain Auks—Variation in the Skeleton of Birds—On Pterylosis of Picidæ—Forms of the Patella in Birds. |

## DONATIONS TO THE LIBRARY.—(*Continued*).

| DATE. | DONOR'S NAME AND TITLE OF BOOK. |
|---|---|
| 1889.<br>Sept. | Geological Society, London.—Abstract of Proceedings, 1888–1889. |
| | Society of Natural History, Portland, Me.—Proceedings, 1881, Oct. 3 to May 2nd—1882, Jan. 2nd to Feb. 20th 1889, May 20 – Report of Commissioner of Fisheries, Maine, 1871, '72, '73, '74, '75, '77 and '79—N. C. Brown's Catalogue of Birds. |
| | Verein fur Erdkunde, Leipzig.—Mitteilungen, 1888, 1889. |
| Oct. | G. F. Matthew.—Recent Explorations in Wappinger Valley, by W. B. Dwight. |
| | Essex Institute, Salem.—Bulletin, Vol. 21, Nos. 1–3, 4–6, 7–12. |
| Nov. | Geol. and Nat. Hist. Survey of Canada.—Contributions to Canadian Palæontology, Vol. II., Part II. |
| | U. S. Fish Commission, Washington.—Report for 1886. |
| | U. S. Geological Survey, Washington.— Monographs — Quicksilver Deposits of Pacific Coast; Fossil Fishes and Plants—Bulletins, Nos. 48 to 53. |
| | The Author.—Siege of Fort St. John's, in 1875, by Lucien [Hyot. |
| | Boston Society of Natural History.—Vol. XXIV., Part I. and II. |
| | W. F. Ganong.—List of publications on protozoa. |
| | E. Gilpin, C. E., Halifax.—Law on Mines and Minerals, Nova Scotia. |
| | The Author.—Coal Mining in Nova Scotia, by E. Gilpin. |
| | The Author. — Compte-rendu, Societé Geologique de Belgique a Spa — Faune palæocine de Copenhagen— Note sur calcaires oolothiques; all by Prof. G. Dewalque. |
| Dec. | The Author.—New Species of Fossil Sponges—On Fossil Plants of McKenzie R.; both by Sir J. W. Dawson. |
| | Geol. and Nat. Hist. Survey of Canada.—Micropalæontology of the Cambro-silurian Rocks, by E. O. Ulrich. |
| | Nova Scotia Institute of Science, Halifax.— Proceedings, Vol. VII., Part III. |
| | United States Depart. Agriculture, Washington.—Bulletin, No. 1. North American Fauna, Nos. 1 and 2. |
| 1890.<br>Jan | Natural History Museum, Rio de Janeiro—Archives of the Museum, Vol. I., Parts 1, 2 and 3. |

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*Finance*, Alfred Seely, Edwin Fisher and J. R. Campbell.
*Press*, G. U. Hay, G. E. Fairweather, G. F. Mattew and S. W. Kain.

## SUPPLEMENTARY NOTE TO ARTICLE I.

(23 December, 1890.)

The writer has lately had opportunity to make a preliminary examination of the minute features of the fossil from Green Head, described in the above article, and finds it to be a protozoon, allied more closely to Cryptozoon than Eozoon. The microscopic characters are most easily recognized in the earthy (as distinguished from the calcareous) layers, and consists of minute, branching canals. Under a one-inch objective the smaller canals have the appearance of minute threads, which run sometimes for a distance of two millimetres without branching. The larger canals branch more frequently and are more sinuous. The canals cross and anastomose with each other; they run chiefly at right angles to the axis of the fossil, and appear to branch most in going outward from the centre. More rarely they ascend from the earthy to the calcareous layer, branching upward.

The organization of this protozoan was evidently quite different from Eozoon, where the canals belong to the supplemental or calcareous skeleton; in this species they are rare in the calcareous, but abundant in the earthy layers, and are chiefly horizontal, while in Eozoon they are represented as mostly vertical. I have discovered no trace of the tubulated layer of Eozoon in the Acadian fossil.

Prof. Hall's description of the canals of Cryptozoon is very brief; they are said to run irregularly in all directions, and his fossil may have a closer relation to ours than this brief description would indicate. Still the mode of growth of Cryptozoon is so radically different, that it can hardly be of the same genus. I would propose, therefore, for the Acadian fossil the name of ***Archæozoon Acadiense,*** with the following macroscopic characters:

Animal growing in closely crowded colonies and forming irregularly cylindrical calcareous columns. The columns are built up of alternating layers of calcareous and earthy (silicate) matter, the calcareous layers being usually thicker towards the outside of the column, and sometimes failing to cover the whole surface. The layers are more or less vaulted, having usually the form of an inverted saucer, though often taking the shape of a bluntly pointed cone; and sometimes they are nearly or quite flat. There is often a space between the columns, which appears to have been filled up by a later, irregular growth.

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Exchange of Publications solicited.

# BULLETIN

OF THE

# NATURAL HISTORY SOCIETY

OF

# NEW BRUNSWICK.

## No. X.

PUBLISHED BY THE SOCIETY.

SAINT JOHN, N. B.,
Barnes & Co., Prince Wm. Street,
1892.

HELIOTYPE PTG. Co.

# Bulletin of the Natural History Society of New Brunswick.

## REPRINTS FROM BULLETIN No. III.

[For several years past Bulletin III. (1884) has been out of print, and the Society has been unable to satisfy the applications made for it. These applications have been mostly for the purpose of obtaining Mr. Matthew's article on the Village of the Stone Age at Bocabec. The Council of the Society has therefore resolved to reproduce this article, and also a list of the mammals of New Brunswick by M. Chamberlain, which appeared in the same Bulletin.

No further work has been done on the collections made at Bocabec, except on the implements of stone, bone, etc. The article on these, referred to by Dr. Bailey in Bulletin VI., is in course of preparation, and will appear in the next number of the Bulletin.

In addition to these there is a collection of the bones of the mammals used for food by the Stone Age people of Bocabec, which have not yet been studied, as well as a few objects of other kinds.

In the years that have elapsed since the exploration was made at Bocabec, death has been busy among us, and, among others, has shorn from our membership one who has been an active promoter of the Society's work since its organization, Dr. George A. Hamilton (at that time a leading physician in St. John) and who, with his family, was one of the camping party at Bocabec.*

The article on Bocabec appears here without alteration or addition, except some slight changes and corrections of error in the typography, suggested by the author. The frontispiece, however, is an addition to the original article, and is from a water-color view of the camping ground made by Miss B. Whitney. The view is from a point in front of the beach at the site of the village, and shows the flat on which the village was situated and the wooded ridge behind it.]

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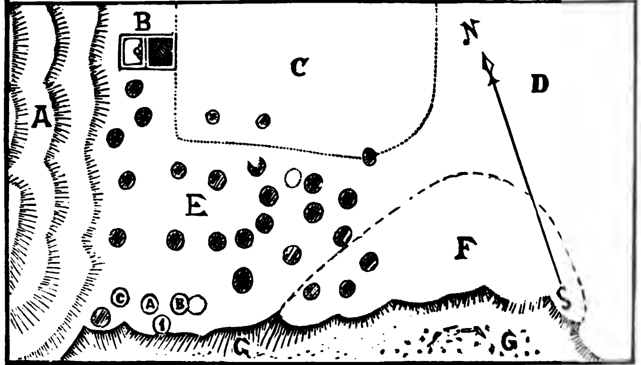
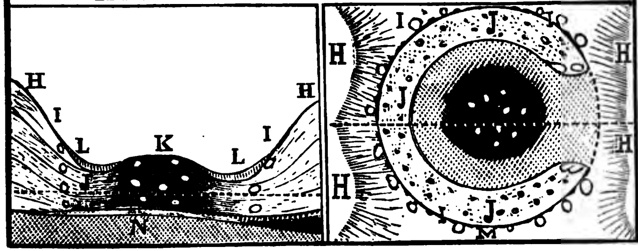
* The party consisted of Dr. and Mrs. Hamilton, Arthur M. Hamilton, Frances Hamtlton, George U. Hay and Mrs. Hay, Joseph Pritchard and Mrs. Pritchard, Geo. A. Whitney and Miss Bessie Whitney, Geo. F. Matthew and W. D. Matthew, all of St. John; and Messrs. W. F. Ganong (now a professor in Harvard) and J. Vroom, both of St. Stephen; and Jas. E. Wetmore, of Grand Lake.

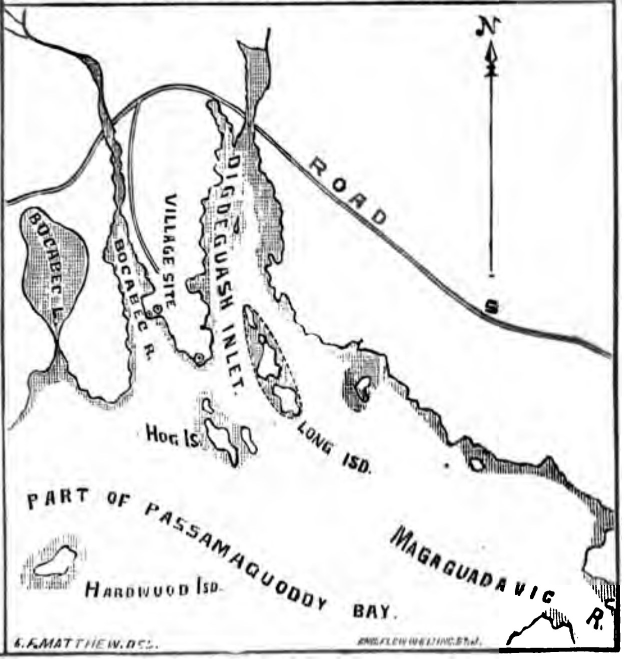
VILLAGE SITE AT BOCABEC.
SCALE 80 FEET TO AN INCH.



HUT BOTTOM "A"
SECTION.
GROUND PLAN



VICINITY OF BOCABEC.
SCALE 2 MILES TO AN INCH.



G. F. MATTHEW, DEL.
ENG. FLEWWELLING, ST. J.

## ARTICLE I.

(*Article II. of Bulletin III.*)

# DISCOVERIES AT A VILLAGE OF THE STONE AGE AT BOCABEC, N. B.

BY G. F. MATTHEW, M. A., F. R. S. C.

(Read 5th February, 1884.)

A number of the members of this Society combined to form a summer encampment in Charlotte County for the purpose of studying, during a short vacation, the Botany, Zoology and Archæology of the above locality. As the work in the last-named branch of study was entrusted to me, it becomes my duty this evening to tell you of the result of our investigation in the kitchen-middens at Bocabec.

First, however, I may mention that our party left St. John by the Grand Southern Railway on 6th August last, and were joined at our destination by other members of the Society from St. Stephen and from Queen's County.

To the Manager of the Grand Southern Railway we owe our thanks for carrying the party at reduced fare, and for transporting our outfit free of charge; and to George F. Hibbard, Esq., and Mr. Alexander Boyd, for much kindness and attention during our stay in St. George and at Bocabec.

### DESCRIPTION OF THE VILLAGE SITE AND ITS SURROUNDINGS.

The spot chosen for investigation was a group of kitchen-middens or shell heaps which mark the site of an abandoned village of the Stone Age at a place called Phil's Beach, near the mouth of the Bocabec River. The site was well chosen, for the advantages of the place are manifold to a people who depended for existence on hunting and fishing. A clay flat, (C, D, E, F,)* flanked on the west by a long projecting hill of felsite rock, running parallel to the course of the Bocabec River, was the spot chosen for the principal settlement. On the east a similar ridge separates the flat from Digdeguash Inlet. To the north of this clay flat, where there is now an open field, the standing forest broke off the keen winds of winter ; and to the south was the sea-beach, where drift wood in abundance was thrown up, and where boats or canoes could be kept, secure from the rising and falling tide.

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* The letters refer to the woodcut "Village Site of Bocabec," on opposite page.

The tide rises from twenty to twenty-five feet at this place; and as the lower half of the beach is stony, it is probable that the savages who dwelt there obtained their principal supplies of shell-fish at some other point. A sandy beach, and therefore one more suitable for clams, exists on the river about half a mile further up than Phil's Beach; and extensive sand-flats abounding with these bivalves are found around the shores of Hog Island, off the mouth of the Bocabec River. These sands, below the surface, are black with accumulated organic matter, resulting from the decay of marine animals (clams, etc..) and would be valuable as a fertilizer of the clay fields found in the valleys along these shores. Sea-fish and marine animals no doubt abounded then, as now, along the whole of this river. Herring and other fish are now taken in great quantities in the weirs at the mouth of the Bocabec.

The position of the aboriginal settlement at Phil's Beach was also very advantageous for hunting. The inhabitants of the village could float up with the tide three miles, to the head of navigation, whence they had a five mile range for hunting beaver and larger game on the branches of the Bocabec River; or by going out of the river and passing into Digdeguash Inlet, a still more extensive woodland tract was open to them. From the mouth of the Bocabec they could also cross Passamaquoddy Bay in various directions in search of seals and sea-birds.

The position of this village was well chosen for defence. Its inhabitants appear to have had an outpost at the point on the eastern side of the entrance to the Bocabec River, whence a view could be had of all canoes approaching from the Digdeguash or Magaguadavic River, or the more open part of the Passamaquoddy Bay. Another section of the settlement occupied a small beach on the Bocabec River a little further up than Phil's Beach, and thus guarded the northern approach to the village.

To the east of Phil's Beach a spring of cool water flows over a low cliff into the sea, and would have given an unfailing supply of this necessary liquid to the inhabitants of the village. In the swale (D) to the east of the village site, now cleared but then probably wooded, a further supply of water was available.

Such was the general relation of the village of Phil's Beach to the surrounding country. A few words may be added as to the arrangement of the dwellings of which it was composed. On first surveying the ground, it was observed that the north side of the village site (C) was comparatively smooth, having been under cultivation since the arrival of the English, and no inequalities remained that would indicate where the dwellings of the ancient inhabitants had been. On this smooth ground we pitched our tents, and found it admirably adapted for our purpose, being well drained by the layers of shells beneath. Fully one-half of the site of the village, however, including the part on which the shells of the kitchen-midden were heaped together in the greatest quantities (C), had never been disturbed by the plow. Here the ground was covered with a growth of the Cow Parsnip (*Heracleum lanatum*), intermingled with other coarse weeds and grasses. This herbage extended to the extreme limits of the village site except, on the north, where the land had been brought under the plow. In the western part of the shell covered area, where the heaps of shells were most conspicuous, the presence of numerous saucer-shaped depressions indicated the positions of the huts of the aboriginal settlement. Over the greater portion of this uneven area no order or arrangement into regular streets could be observed. But near the sea beach, on the southern side of the village site, there was an approach to regularity in the position of the hut bottoms. The front row of huts (A,B,C, etc.) appears to have been the favourite section for dwellings. Not only were the foundations of the huts more closely set in this row, but the refuse heaps both before and behind them are larger than elsewhere. The huts of this row are very closely set, with alley-ways between, in some cases only four feet wide; but the spaces between the huts further back are greater. Such at least was the arrangement of the huts in the later years during which this community existed. Not only were the huts more scattered in the rear part of the village, but anything like a systematic arrangement in rows entirely disappears after passing the third row from the front of the village.

Of the depressions marking the hut bottoms of the front row, which as I have said, were more closely placed than those further back, one was much longer and deeper than the rest. This, at first sight, gave the impression of a long communal dwelling, and here we determined to begin our exploration. In digging a trench through a part of this depression we struck an ancient fire-place, which was made the centre of exploration for several feet around. It was found that at this point the deposit in the hut bottom was about two feet deep, but its fire-place rested on an older kitchen-midden, or refuse-heap beneath.

### HUT BOTTOM NO. 1.—ITS ANTIQUITY.

The hut bottom of which the first named fire-place is the centre is distinguished on the plan as hut bottom A. The older shell-heap beneath (marked No. 1) differs in several respects from that of hut bottom A; there was much less charcoal mingled with the shells, and fish-bones were more plentiful. When also we had traced this lower kitchen-midden in different directions beneath and beyond hut bottom A, we found stone chips or flakes, which had been struck off in the manufacture of weapons, differing in kind from any that were met with at the higher levels. The weapons found in the lower kitchen-midden were also larger, coarser, and of a different form from those exhumed from the hut bottom and waste heaps of A. Fragments of bone harpoons were more plentiful at the lower horizon, the pieces of bone more fragile, and the stone chips more abundantly coated with carbonate of lime than at the higher levels. There were also differences in the patterns of the pottery found in the two deposits. The ornamentation of the fragments of pottery found in this lower kitchen-midden was made with a pointed instrument having a smooth round point, but that of all the pottery obtained from the higher levels was impressed with a tool having a square or angular point,—all seemed to point to a want of continuity in the arts and habits of the men of the older kitchen-midden, and those who made the shell-heaps and occupied the hut bottom of A; and it seems possible that the former belonged to a different tribe or race from the latter.

I am the more confirmed in this impression that there was an older and independent occupation of this camping ground, from the discovery near the edge of the bank overlooking the sea beach, in and beneath the oldest kitchen-midden, of an ancient fire-place, so situated that it must have belonged to a hut whose foundation has been partly swept away by the sea; and which was therefore erected and occupied when the bank extended further out than it does now, and also further out than when the inhabitants of hut bottom A lived there. This older fire-place is marked on the plan as hut bottom No. 1. It was planted on a fresh layer of gravel apparently spread over the original land surface by a storm or by the surf when the land was lower than it is now, as the gravel fills up the inequalities between the stones which are scattered over the clay flat. There was but a film of vegetable mould between this gravel and the clay, from which it may be inferred that hut bottom No. 1 marks a very early occupation of the site. The clay upon which the layer of gravel was spread, is the Leda or Champlain clay of geologists ("N" in section of hut bottom), and it does not seem likely that a very long time elapsed, after this portion of the land was raised above the sea, before it was occupied by man.

The foot-hold thus obtained at the sea-side by the dwellers of hut-bottom No. 1 seems to have been precarious, and when their successors came they placed their camps further back, and found a permanent site, safe from the encroachments of the sea.

### HUT BOTTOM A—ITS FORM AND THE HABITS OF ITS OCCUPANTS.

As I have already remarked, the site of hut bottom A and its associated dwellings had on the surface the appearance of a communal dwelling, which was eight feet in breadth by thirty long. As our explorations progressed it was found that this oblong depression did not mark the foundations of a single hut but of several placed close together in a row. The exact form and size of the typical hut was disclosed by a layer of clean beach gravel, which we met with about fifteen inches from the surface (J). This layer formed a ring around the fireplace, at a distance of from two to three feet from its centre, and was bordered all around by the shells of a kitchen-midden (H). The ring of gravel was about three inches thick in its deepest part, and was continuous except on the south side, where a break about four feet long marks the position of the door. Here the ends of the gravelly layer were upheld or bounded by a few large stones.

This gravelly stratum was found to form the boundary of a hut bottom, less than one-third of the length of the whole depression occupied by the row of hut bottoms; the hut bottom had a diameter of eight feet. Around the margin of this foundation there were imbedded stones (I) of various sizes that appear to have been used as supports or wedges for poles of which the frame work of the hut was composed. No remains of these poles or of any wood work was discovered which could be referred to the time when this village site was occupied by an aboriginal people.

There are two peculiarities in the foundation of this hut which would lead to the inference that the hut was conical. The first is the relation of the kitchen-midden to the gravel of the sleeping-bench. In making a trench through this hut bottom, and others adjoining, sections of several layers of gravel marking such sleeping-benches were passed through at various depths in the deposit; and in all, the outer edge of the gravel of the sleeping-bench was found to be overlapped by the shells of the kitchen-midden, as though the shells had fallen in upon the gravel after the decay of the poles which had supported the walls of the hut. This overlapping of the shells might, however, have been caused by the heap of shells outside the hut growing more rapidly than the *debris* accumulated within it; and then on the decay of the walls of the hut these shells would fall in on the gravel of the sleeping bench. A second feature in the appearance of this foundation, which seemed to indicate a conical form to the dwelling, was the width between the ends of the gravelly layer of the sleeping-bench of hut bottom A. If this space corresponds to the width of the doorway it would be quite out of proportion to the size of such a dwelling, unless the doorway was rapidly narrowed above by the convergence of the poles supporting the sides of the hut.

The careless habits of the old Neolithic people who dwelt on the shores of the Bocabec were quite noticeable, and certainly were favorable to the spread of disease among them. I have said that they underlaid their sleeping banks with gravel, and in this practice they shewed their appreciation of the comfort of a dry bed. This couch they no doubt made softer by covering it with boughs, and warmer by the added luxury of fur-skins. Nevertheless, in some respects they were exceedingly slovenly. The ashes and charcoal of their fire-places (K) gradually accumulated to such an extent that to level up the sides of their huts they brought in gravel and threw it on the trampled clam shells and other fragments of their feasts that were scattered over the floor. They were too slothful to clean out the smaller fragments of bone, etc., and so it happened that in the course of time the stones around their fire-places, which were used to support the firewood and the pots, were gradually buried up, and fresh stones had to be brought in to raise the wood above the embers and to support the cooking vessels. If the occupants of a hut were careless enough to break a pot, it was more than probable that the fragments would be allowed to lie on the floor and be trampled under foot, until buried out of sight among the *debris* scattered around the fire-place. The bones left after dinner received much the same treatment. When the flesh was eaten off the leg-bones, they were broken up for the marrow they contained, and, with the smaller bones, were left scattered around on the floor, or perhaps the larger fragments would be flung carelessly out of the door and left to fester in the sun. Occasionally a fit of house-cleaning would seize upon the occupants of one of these huts and the fragments lying within on the floor would be scraped together and shovelled out at the door to mingle with the heaps of shells and broken bones without. The evidence of these actions on the part of the inhabitants of hut A is found in the frequently alternating layers of charcoal mingled with broken bones, of pottery clay and other refuse from the hut, which are found in the kitchen-midden before the door (H). These occur with considerable regularity and frequency, in alternation with layers of clam shells which form the bulk of the shell heap. Owing to these occasional house-cleanings, and the vast quantities of clam shells thrown down around these dwellings, the kjokken-modding increased much more rapidly than the deposits within the huts; and although fresh material was frequently brought in to level up the interior of the huts, the boughs and perishable matter within gradually decayed away and the floors sank down, so that now the depth of the deposit within the site of the huts is only about half as great as that of the shell heaps without.

The fire-place (K) of this hut was found to have been kept in the same spot from the time the hut was first built, almost until the settlement was abandoned. Such, however, was not the case with an adjoining hut bottom (B), which was gradually shifted to the east, so that at the close of the occupancy of this village site it was about two feet from its original position. A similar want of permanency in the position of the individual hut was found to exist in other hut bottoms. The huts, therefore, must have been re-built from time to time, and perhaps were deserted for a part of the year.

There seems, however, to have been sufficient permanency to these hut bottoms to warrant the assumption made in a preceding page, that each saucer-shaped depression in the kitchen middens of this village marks the site of a hut.

From the present aspect of the surface of the kitchen-middens at this village site, a rough approximation to the population of Bocabec River during this latter part of the

Stone Age may be obtained. In that part of the higher portion of the main village site which still remains undisturbed by the plow, there are depressions marking the position of about thirty hut-bottoms. Allowing four individuals to each hut, there would be in this part of the village a population of about 120. But behind this part of the village, which has been ploughed over, there is an area of about equal extent covered by shells; and an additional tract of about the same size, more or less covered by kitchen-middens, lies to the east of the higher part of the village site. At times, on the basis above given, a population of 300 may therefore have lived at the main village at Bocabec. But it is probable that half this number would be nearer the ordinary population of the place.

It appears to have been the practice of the women who dwelt in hut A, to stow away their needles, pins, and other articles of use or adornment at the back of the hut, and here they would occasionally slip down and be lost between the couch and the poles and stones of the outer wall. Several of the bone implements taken from this hut bottom were found in such places.

### MANUFACTURE OF POTTERY.

One of the occupations of the women living at Bocabec was the manufacture of pottery. On the western side of hut bottom A was a pottery-yard, or place of deposit, where the occupants of this hut kept a supply of clay for the manufacture of pots and earthen vessels. These people had ready to their hand, in the flat of land which they had chosen as a site for their village, a good tough clay, well suited for making pottery, when mixed with a due proportion of sand. Nevertheless, they do not appear in any case to have used it, but took the mud of the sea-shore, near low-tide mark, for the manufacture of their ware. Such I infer to have been the case, for in the course of our excavations we came across patches of pottery clay in various spots, and at several levels in the hut bottoms A, B, and C, and kitchen-middens adjoining them, and in all cases the material thus used was beach-mud, mingled with numerous shells of mussel and clam. In preparing this mud for use, these women of the Stone Age picked out the coarser stones and gravel and many of the shells before moulding and baking their pots. But in consequence of the imperfections of the material used as the basis of their pottery, and the very imperfect firing to which the ware was subjected, it was exceedingly fragile. The coarseness of the clay used in the manufacture, as well as these defects in the material, and the imperfect baking, compelled these potters to make their ware quite thick, in order to obtain the necessary strength. Their vessels were seldom less than three-eighths of an inch thick in any part, except near the rim, and the bottoms were usually about half an inch thick. As I have already remarked, the women appear to have been slovenly in their housekeeping, and as an added instance of this trait I may mention that the charred remains of their pottage still clings to the fragments of their vessels. In the fine charcoal and ashes around the fire-place of hut bottom A were found numbers of parched peas or vetches and of a round seed of the size of those of the radish, as well as grains apparently of some kind of grass. The peas were about the size and appearance of Beach Peas (*Lathyrus maritimus*, Big.), a plant which now grows plentifully at high-water mark on the beach in front of the village site.

But while animadverting upon the carelessness these people in some respects, it is only just to give them credit for a considerable amount of rude taste in the ornamentation of their pottery. Upon the fragments found at the three hut bottoms we examined there are no less than ten distinct designs or patterns impressed upon the surface of the ware. Some of them are quite ornamental. A favorite style of ornamentation consisted of continuous parallel lines made with pointed tools ; but a more elegant pattern was a chevron, consisting of rows of short diagonal lines impressed in this manner. We did not meet with any of the tools by means of which these patterns were impressed upon the pottery. A small implement with a square point seems to have been in common use, and another is indicated with several teeth by which certain rows of scolloped indentations were made, The lips of several of the vessels were ornamented with diagonal rows of indentations apparently made by an implement having three teeth.

Some of the patterns indicate a different process of manufacture from the last: these show the print of a coarse woven fabric on the outside of the vessel, and sometimes also within. On some fragments this pattern has the appearance of a fine basket work, and may have been used to preserve the form of the vessel, as well as to ornament the surface. On other pieces of the terra cotta the pattern very closely resembles that left on bread by the coarse osnaburg used by bakers to cover their dough. Fragments of another pot were found which bore the impression of flattened bunches of grass or rushes.

One pattern of the class first referred to, consisting of square, incised dots, is precisely like the marking on some fragments of pottery which I met with about fourteen years ago at Oak Bay, on the western border of Charlotte County. A fragment of pottery found at Bocabec bears the imprint of a leaf of the fir tree (*Abies Americana*) that had been incorporated with the clay of the vessel before baking. It is not probable that this little leaf was in the clay when taken from the mud-flat of the Bocabec River, for being light, such a leaf would have floated on the water and been stranded near high tide mark. We can imagine that it may have fallen from a neighboring tree, or have stuck to the clay when it was thrown down beside the hut. Here we may fancy the crouching potter unconsciously kneading it in as she prepared her clay, and gave form and beauty to her work; little thinking that she thus gave permanency to the outlines of a little leaf which perished ages ago; or that she was adding another line to the history of her people.

Some of the patterns on the fragments of pottery from Bocabec are very like those on the sherds obtained by Dr. L. W. Bailey at the thoroughfare of Maquapet Lake; but the designs are not so elaborate; yet, there appears to have been much in common between the men of the river and those of the sea shore, in this art, as well as others.

In the relative culture of the river Stone-men of Acadia and those of its sea coast, we seem to have a parallel to that observed in Denmark by Prof. Steenstrup between the weapons and implements of the men who erected the tumuli and those who left the Kjökken Mödding in that country, but the differences between the work of the inland people and those of the sea shore in Acadia do not appear to have been of so marked a character as that between the work of the corresponding populations in Denmark. We have as yet, however, but small collections to test this point, but I may mention incidentally that some of the skin scrapers from the St. John River exhibit a high finish, and are equal to the most perfect figured by Evans, as found in the barrows of Britain.

### IMPLEMENTS AND WEAPONS OF STONE.

Though their pottery was coarse, the people of Bocabec showed a great degree of proficiency in another art, namely, the manufacture of implements of stone.

This industry we may suppose was in the hands of the men, and some of the implements obtained show that it was brought to great perfection.

If Longfellow was right, this work was carried on by the North American Indians outside of the hut. The poet's graphic description of the arrow-maker of the West, sitting by his hut door and meditating upon the exploits of former days, is well known. I cite it, as I think it will be seen that his habits did not in all respects agree with those of the arrow-maker of the Stone Age in Acadia.

> "At the doorway of his wigwam
> Sat the ancient Arrow-maker,
> In the land of the Dacotahs,
> Making arrow-heads of jasper,
> Arrow-heads of chalcedony." . . .

Truth, however, compels us to declare that the arrow-maker of Bocabec conducted his operations chiefly within doors. Nor do I suppose that he worked within the hut on account of any special secret in the manufacture, but for other reasons that I will endeavor to explain further on. By far the best work in this line of art at Bocabec was found within hut bottom A, where the chipping of the lance and arrow-heads was performed beside the fire-place on stones or supports placed near the fire. The flakes resulting from the manufacture of these implements were very plentiful in this part of the hut bottom. Very few flakes were found outside the hut, and these mostly beside stones used for wedging the poles of the frame-work that supported the covering of the hut. In the kitchen-midden, flakes are quite rare. It would, therefore, appear that the arrow and lance-heads were fabricated beside the fire-place, and apparently at times with the help of the fire-light, for the flakes were more abundant at the sides and back of the fire-place than in the front. The lance-heads were flat, and of a long oval pattern; a narrower and thicker point, of which one example was found, was probably a javelin-point; and another that was triangular and barbed at the base, would be regarded as a spear-point. All the weapons of this type that we met with were made of petrosilex or a highly quartzose felsite, and most of the arrow-heads were fabricated from these rocks, but we found a few that were made of quartz and jasper.

The arrow-points were chiefly of three patterns, viz., lozenge-shaped, lanceolate leaf-form and triangular, with lateral notches for securing the point to the shaft. Many of these arrow-points were rudely made, others more highly finished. The workmanship on one of the triangular, notched arrow-points of petrosilex rock could not be surpassed. It was finely serrated on the edges and had a fine tapering point. Another arrow-point of laurel-leaf form made of quartz was also quite symmetrical.

There was a remarkable scarcity of axes and of the larger stone implements at these hut bottoms. Only one well-formed axe was found, and this was in the kitchen-midden under hut bottom B. A very large, ovate, lance-head of quarzite accompanied this axe. In this lower kitchen-midden, which is connected with the hut bottom No. 1 already referred to, there were many flakes of a dark brown petrosilex of coarser grain than the black petrosilex from which many of the weapon-points of the higher kitchen-middens and hut bottoms were made. Quartzite rock was more largely used in the manufacture of weapons by the inhabitants of hut No. 1 than by the men who subsequently occupied the place.

Some rougher axes and hammer-stones were found. These larger implements for rough work were chiefly made from diorite or quartzite, rocks better suited for standing heavy blows than the more fragile petrosilex and quartz.

Among the objects from Bocabec are a number of skinning knives. Those which showed the most careful chipping were rectangular in outline, like some agate knives found on the St. John River. Several, however, were lunate or oval. The material used in the manufacture or these knives was either quartz or petrosilex, mostly the former. Numbers of stone flakes, chiefly of petrosilex, which had the form of rude knives, were found. Some of these, in their worn edges, gave evidence of having been used for cutting. These flakes are of various forms, some approaching scrapers in appearance, others are simply sharp flakes which do not appear to have been applied to any special use. The skinning-knives were made of quartz and petrosilex, but a large majority of the knife-flakes were formed of the latter rock. Quartzite knife-flakes were comparatively scarce, and came mostly from the shell-heap of hut bottom No. 1.

The most curious stone implement found at Phil's Beach was one obtained by Mr. Alexander Boyd, the proprietor of the place. This implement was unearthed from the kitchen-midden behind hut bottom A by Mr. Boyd, when he was removing shells to spread on his land. It consists of petrosilex rock, and in form resembles a short femur of a large reptile; it is smoothed by rubbing at each end, and may have been used as a slick-stone for softening skins.

Other stone implements of a long oval form, which from their appearance are supposed to have been used as slick-stones, were found at hut bottom A. Here also we met with a long cylindrical stone which had probably been used as a pencil, for small facets have been formed on the end of it by rubbing.

Scrapers in great numbers were found in the hut bottoms of this village site, but they were as imperfectly made as they were numerous, and none were met with that possessed the artistic finish of the agate scrapers found on the shores and tributaries of the St. John River.

Though thus lacking in elegance, the scrapers found at Phil's Beach, Bocabec, present a variety of forms, and were no doubt intended for various uses. Beside the ordinary scraper, which in form may be compared to a gun-flint with rounded corners, and which was used for dressing skins, there were several kinds that were probably used as carpenters' tools. Some of these had chisel-shaped extremities, and, secured in a handle of bone or horn, would have made very serviceable little chisels. Other gouge-pointed forms would have been useful implements for scraping the insides of hollow bones, such as are found shaped into needles, bodkins, etc. In others the outline of the scraping edge was concave; these would have been suitable for scraping the wooden shafts of arrows or any other rounded surface of wood or bone. It was in hut bottom C that the greatest variety of these implements was found.

As hut bottom A was characterized by the variety and perfection of its stone weapons, so hut bottom C, by the presence of numerous scrapers, gave evidence of the operations of the artificer in wood. Quartz, being a harder stone than petrosilex or felsite, was the favorite material for scraping tools; but many of the scrapers made of this rock were merely rough flakes, to which a fresh edge was given by flaking minute chips from the margin, and the tool thus restored was used again. This habit of the men of Bocabec reminds us of the manner in which window glass is now used by cabinet makers for similar purposes, a fresh edge being obtained by breaking the glass, when the old one has become dulled by use.

By far the greatest number of scrapers were made of quartz; but beside those made of petrosilex (and these were numerous), there were a few of agate, jasper and chalcedony. No veins of agate or chalcedony are known to occur near the Bocabec River, but these minerals could have been procured at Grand Manan Island to the south, or on the St. John River to the north. Two scrapers made of these varieties of quartz shew a remarkable amount of weathering, as though they had been in use for a long time.

The source of supply for the material from which the greater part of the stone weapons and implements of Bocabec have been fabricated is not far distant from the site of the village. The whole northern and eastern side of Passamaquoddy Bay is bordered by trap rocks and sedimentary rocks which, from the fossils found in the slates at the base of the series, are regarded as Upper Silurian. The lower part of this formation with marine fossils, which in the Reports of the Geological Survey of Canada are described as Division 1, are absent from the outcrops about Bocabec, which expose at the base of the terrain, Division 2. This part of the terrain which, in the most southerly outcrops in Charlotte County, consists of hardened silicious shales, is represented at Bocabec by a fine-grained petrosilex, exposed in Digdeguash Basin, and probably also on Bocabec River. This rock splits with a deep conchoidal fracture, and is capable of being worked like flint or chert into stone weapons. It is this material which the men of Bocabec found most advantageous for the fabrication of lance and arrow-heads.*

In the Third Division (Div. 3) of the Silurian series of rocks, flaggy sandstones are common on the southern margin of Passamaquoddy Bay; but at Bocabec, which is at the head of the same Bay, this number of the series is found to be very compact and fine-grained, coming under the the denomination of quartzite. This rock has been used to some extent by the dwellers of Bocabec for their larger weapons and implements.

A third rock, or rather mineral, quartz, was one of which the men of Bocabec availed themselves to a large extent in the manufacture of stone weapons. As this mineral occurs abundantly in the pebbles of the drift and other surface deposits of the region, it is plentiful on the sea beaches, which abound with stones washed out of these surface deposits, and no special source of supply need be looked for.

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*This rock is sometimes called hornstone; it is not however a hornstone which is a splintery or flint-like variety of quartz, but it is a fine grained, siliceous, sedimentary rock, baked or hardened. It differs from felsite, which develops numerous joints when weathered, and so is unsuitable for flint implements.

From the fact that many of the rocks and minerals used by the community of Bocabec for weapons and implements were found so close to their homes, we have good reason to suppose that there was very little occasion for these men of the Stone Age to seek them elsewhere by barter.

### IMPLEMENTS OF BONE AND IVORY.

Bone implements of various kinds were found both in the hut bottoms and in the kitchen-middens, but mostly in a fragmentary condition. The most abundant were bodkins of a rough type. These were made in most cases by pointing split pieces of the leg bones of moose, deer or other large animals. An implement like a bodkin in form, but hollow, and having a slit sawed or cut at the smaller end, was made of the leg bone of a bird. Not knowing the use of this implement, I sent it to Dr. Daniel Wilson, of Toronto, for examination. He thinks "it may be assumed with much probability that it is a modelling-tool, such as the Western Indians still use in the fashioning and ornamenting of their finer pottery."

Several fragments of netting needles, or implements which for their size and form appear to have been available for this use, were found, and one perfect needle of this kind, about eight inches long, was met with. It had one eye about the middle; another broken needle had two perforations. Many fragments of channelled bone implements, which appear to have been pieces of needles and bodkins, were exhumed from the hut bottoms. The harpoons were of the ordinary form, with lanceolate point, and barbed on one side. Only fragments of this kind of implement were obtained.

Among the worked bones which are not, strictly speaking, implements, there was one which was scored on the back, and another that was notched on the edge. Such bones may have been of the nature of tally-sticks; but Dr. J. W. Dawson suggests that objects of this kind, which are also found among the ancient relics in European caverns, may have been used for playing games, small pieces of wood, ivory and bone being carried about by the Indians of British Columbia at the present day, and used like playing-cards.

Of ivory implements the only ones found were made of the tooth of the beaver. By cutting the point of the incisor of this animal in various ways, chisels, gouges, and other pointed implements were formed. These would be used where the material to be operated upon was not too hard, and such implements were more easily made than the quartz scrapers or tools.

### ANIMALS USED FOR FOOD.

In our operations at Bocabec a great many bones and fragments of bones of various animals were unearthed. I have not yet had time or opportunity to have these determined, but it is certain that quite a number of species are represented. The beaver is perhaps the most abundant, for the lower jaw and the femur of this animal were constantly turning up in our excavations. The leg-bones of moose and of deer or cariboo (reindeer) were also of frequent occurrence, but were almost invariably broken to pieces for the marrow. The hare, the fox and the bear were indicated by teeth, jaws and limb-bones. Bones of birds are frequent, and represent those of wading, aquatic, and arboreal habit. A number of bones, which from their spongy texture are supposed to be those of marine animals, were found. Fishes are represented by remains of the cod, herring, sculpin and shark.

But the remains which form by far the greatest mass in the kitchen-middens at Bocabec are those of *shell-fish*. Among these, pre-eminence must be given to the clam (*Mya arenaria*), which makes up perhaps nine-tenths of the bulk of the molluscan refuge.* The horse-mussel (*Modiola modiolus*) and the long-whelk (*Buccinum undatum*) are the most numerous of the other molluscs found in the refuse heaps of this village. After these species may be named the round-whelk (*Lunatia heros*) and the small purple-shell (*Purpura lapillus.*) The rock-periwinkle (*Littorina rudis*) is occasionally found, and so also is the bonnet limpet (*Crepidula fornicata*); but the common European periwinkle (*Littorina litorea*), now so common on this coast, is entirely wanting. Beside these, a single valve of the large scallop (*Pecten tenuistriatus*) was found.

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* The following paragraph from the St. Croix *Courier* (1892), published at St. Stephen, N. B., is of interest in connection with the great abundance of the shells of this mollusc. "Mrs. Brown [Mrs. W. Wallace Brown, of Calais, Me , whose husband was formerly Indian Agent] has been told by the Passamaquoddies that the shell heaps were left by their forefathers ; who, they say, made autumn encampments on the shore, for the purpose of getting a winter supply of clams. They chose a spot from which it was easy to get back to their winter hunting grounds; therefore the shell heaps are usually found near the mouths of navigable streams. The clams were put in an oven, and cooked just enough to be taken out of the shells easily; and were then dried on sticks. This preserved them and made them light and easy to carry. Several households they say used the same oven, which accounts for the great number of shells in one place The saltness of the clams made them an important article of food; as salt was unknown in its crystalline form." [It is evident however, that the men of the Stone Age did not visit Bocabec solely for the purpose of laying in a store of smoke-dried clams.—G. F. M.]

The sea urchin is present, but may have been introduced accidently by crows, and not have been brought intentionally from the beach by the former residents of Bocabec. Other posthumous or accidental additions to the fauna are the land snails, of which several specimens were found at various levels in the shell heaps. Among the species found here, *Helix alternata*, Say, is by far the most abundant. *Helix albolabris*, Say, was not very common. Several specimens of *Helix hortensis*, Müll., were observed, but this species has probably been introduced since the arrival of the English. A species was found which agrees with Binney's description of *Helix Sayii*, except that the tooth on the parietal partition is nearly obsolete. Among the smaller snails were *Helix monodon*, Rack, *Hyalina arborea*, Say, *Hyalina multidentata*, Binn.

Vanity is a foible quite as prevalent in savage as in civilized communities, and we are not surprised to find indications of it among the dwellers at Bocabec. Among the *reliquæ* of their hut bottoms was a fragment of a stone pendant decorated with crossed lines in the form of a lattice, and two kinds of powder, which appear to have been kept in valves of the common clam. One of these powders is made from galena ore, small veins of which occur on the islands of Digdeguash Inlet, near Bocabec. The powder has a glistening appearance The other powder, which was formed of pulverized shells of the horse mussel, could have been used as a white paint. These powders would appear to have been a part of their toilet requisites. That such has been the use of the glittering galena seems highly probable; and Darwin, in his account of the native Fuegians of South America. who subsisted on a diet similar to that of the Stone men of Bocabec, records their appearance as follows: "These poor wretches were stunted in their growth, their hideous faces *bedaubed with white paint,* their skins filthy and greasy, their hair entangled, their voices discordant, their gestures violent, and without dignity."

### PERMANENCY AND ANTIQUITY OF THE VILLAGE.

It has been thought that these kitchen-middens around the shores of Passamaquoddy Bay were made by a people who camped along the shore in summer for fishing and hunting, but retreated inland to the shelter of the woods in winter. There are, however, indications that the occupation of the village sites marked by these shell-heaps was more or less continuous.

Among the indications of occupancy at other seasons than the summer, I may refer to the kind of clay used in their pottery, and the places in the village where deposits of this clay were found. In making sections of the three hut bottoms at Bocabec we passed through several layers of pottery clay of small lateral extent, which had evidently been scattered on the floor of the huts. So also in the kitchen-midden in front of hut bottom A, irregular layers of the same kind of clay were traversed. These layers were mingled with the charcoal and refuse that had been cast out from the door of the hut in such a way as to show that all had come from within the hut. I think, therefore, there can be little doubt that the moulding of the pottery was sometimes carried on within the huts. The practice of chipping their flint implements within the hut, to which I have already referred, would also indicate the use of these dwellings during the colder part of the year.

The very fact of these savages using only the mud of the beach in the manufacture of their pottery, seems to show that the work in terra-cotta was carried on mostly in winter, when other and better kinds of clay (for no other kind has been found in the sherds collected at Bocabec) were inaccessible to them.

The position of the encampment also, situated as it was on the edge of an open beach facing the south, and sheltered from the north-west and north-east winds by protecting ridges of land, was well adapted for a winter residence.

With our very imperfect knowledge of the shell-heap folk of Passamaquoddy Bay and of the remains they have left, it would be premature to say how long these kitchen-middens have been lying in their present condition, or when the various village sites marked by accumulation of these remains were abandoned. It may, however, be worth while to mention a few points bearing on the question of their age.

Among all the weapons, implements, and other objects found at Bocabec, not one article has been met with which in any way would lead to the supposition that these people were acquainted with the products of European industry. Mr. W. F. Ganong informed me that at a group of kitchen-middens at Chamcook, near St. Andrews, not far from the spot where De Monts wintered with the first colony of Europeans who attempted a settlement in Acadia, an iron-bound copper kettle had been found. I am not aware of the conditions under which the discovery was made. No trace of any object formed of metal or glass was detected at Bocabec. The stone weapons and implements were made of material occuring on the Bocabec River, or in its neighborhood, or at least not farther off than the St. John River. Two of the scrapers, one of chalcedony and the other of agate, shewed quite a deep weathering and must have been for a long time exposed on the surface of the ground. Nevertheless, the tools of felsite, which are more easily affected by the weather, do not give indications by the condition of their surface of very great antiquity; and the two scrapers of chalcedony and agate may have been the implements of an earlier people found and used by the latter dwellers at Bocabec.

An inference regarding the antiquity of this village site may also be drawn from the covering of vegetable mould which has gathered on the surface of the shell-heaps to a greater or less depth in different places. In the hollows, and especially over the hut bottoms this mould has attained a considerable depth, in some places as much as a foot or eighteen inches.

But while on the one hand these conditions point to a period anterior to the discovery of America, or at least of the region of Acadia, by the "White Race," as the time when the shores of the Bocabec ceased to be occupied by the people whose remains we have examined; on the other hand, their sojourn on its banks, when compared with the whole length of the Stone Age, was both recent and short.

In the Old World, the Stone Age has been divided into two great periods — the Palaeolithic, or the time when mankind used implements and weapons of chipped stone only, and the later Neolithic, when weapons of ground stone were also employed. The length of time embraced in the earlier of these periods is very great. Since its beginning the river valleys in Western Europe have been very much deepened, and the courses of the rivers in some cases changed. Man, who at first hunted the Siberian elephant, the rhinoceros, the cave bear and other large animals now extinct, used at first large and roughly made axes of chipped stone. Subsequently he found his large game chiefly in the horse and reindeer, and the stone-pointed spear became more prominent as a weapon of offence. In later times, but still while using no stone implements but those made by chipping, he hunted various wild animals more nearly like those which existed in Europe in the times of the ancient Romans. His weapons now were made smaller and lighter. Such in outline was the condition of man in the Palaeolithic Age.

The Neolithic period of Europe, or the time when man in that region used weapons of ground and polished stone, is of a later date than the Palaeolithic times I have glanced at.

No such continuous history of man in America is yet known, for the subject is only now receiving the attention which has been bestowed upon it in Europe for many years, and the landmarks of the older civilization of the Old World seem to be wanting in the New. When the American Indian of this region first became known to Europeans he was still in the Stone Age, but his weapons and his arts were such as to show that he had arrived at a condition of culture equivalent to the Neolithic Age of the rude inhabitants of Europe. Discoveries have, however, lately been made which make it highly probable that there was an older and ruder age in America as well as in Europe. Dr. Abbot, the pioneer in this line of research, has found in the gravel terraces along the Delaware River at Trenton in New Jersey, rude stone implements which far antedate the occupation of that region by the tribes known there when the continent of America was discovered. Most of the objects found were very rudely chipped, and belonged to a people of very primitive habits. Within a year or two a similar discovery, consisting however of stone chips only, was made in the terraced deposits of Central Minnesota.

With such buried remains of man's occupancy of the earth our Bocabec relics do not compare, as they rest upon the surface, and are unquestionably less ancient. I have already referred to some of the geological evidences of the recent accumulation of these relics, but I may mention other features which stamp these remains as those of a recent Neolithic people. At the very bottom of these shell-heaps stone axes were found which, though rudely formed, were fashioned by grinding; and although the pottery found with these rude implements differed in pattern from that occuring in the higher levels of the shell-heaps, in other respects it showed nearly the same stage of advancement in the ceramic art.

It is somewhat surprising that there should be no evidence of forest growth on the shore of Bocabec River at the site of the village when first it was occupied by these men of the Stone Age, for a mere film of vegetable matter is all that separates the oldest kitchen-midden from the clay below, while the mould above the shell-heaps is from three inches to one foot in depth. These people, however, may have been driven back by the encroachment of the sea upon land in the rear of their former huts, which they had already cleared of trees and vegetable mould.

### ETHNIC RELATIONS OF THE PEOPLE.

Finally, as regards the origin of the people who made these kitchen-middens at Bocabec a few words may be said.

The habits, manners and customs of the people who were known as the aboriginal inhabitants of this country when Champlain discovered the Bay of Fundy have greatly changed through the corrupting influence of contact with the new comers. Enough of their old habits and mode of living remain, when considered in the light of the accounts that have come down to us from the early explorers, to establish the similarity of their habits and mode of living to that of the men of the Stone Age who lived at Bocabec. Furthermore, the indication of a conical form to the huts, which I think is sufficiently shown by the over-lapping of the kitchen-midden upon the sleeping bench, and by the great width of the base of the doorway of the hut, point strongly to a resemblance between these huts and the well-known wigwam of the Indians.

The choosing of a small beach for the village site, the fact that they appear to have had canoes or boats of some sort to transport the vast quantities of clams which formed an important article of their diet, and which could not have been dug with ease or found in sufficient quantities in front of their village (for, as I have said, the principal clam-flats are at some distance from the village), the capture of fish which would not take the hook, but must have been taken by spear, harpoon, weir or net; the dependence of the people on hunting for the more acceptable variety in their food; the character of the rude pottery; the use of coarse woven fabrics, and a variety of other features of their culture and mode of life, are such as we know to have been common to them and the Indian tribes of Acadia.

We are, however, far from having absolute proof that these stone-age people were of the same race as the present (so called) aborigenes of the country. One needs only to read Sir Wm. Dawson's "Fossil Man" to see how many points of analogy there are between customs, tools and weapons, the remains of art, the methods of the chase, and the mode of life of the men of the stone-age in Europe and of the Indian tribes of North America. The various features of the culture and arts of the men of Bocabec are thus not necessarily those of an Indian tribe, but rather that of a people who had reached a stage of advancement similar to that in which the "Indian" nations were found when the Western World was revealed to the gaze of Europeans.

## REFERENCE TO WOOD-CUT.

### EXPLANATION OF VILLAGE SITE.

**A** — Rocky ridge on west side of village.
**B** — Ruins of "Phil's" House.
**C** — Area of plowed land,—level—covered by a layer of clam shells about 3-10 inches thick; here the hut bottoms are obliterated.
**D** — Swale — uneven surface, covered with weeds and bushes, and having scattered shell heaps.
**E** — Part of the village undisturbed by the plow. Kitchen-middens deep and hut bottoms distinct:
**F** — Low part of the swale, with irregular hillocks and shell heaps, now liable to be swept by the surf in heavy gales.
**G** — Gravelly sea-beach in front of the village.

The hut bottoms which have letters or numbers are those where the excavations referred to in this article were made.

### EXPLANATION OF HUT BOTTOM "A.

**H** — Kitchen-middens before and behind the hut bottom.
**I** — Stones at the outer margin of the hut bottom.
**J** — Layer of beach gravel, used to raise the sleeping bench, outlining the form of the hut bottom.
**K** — Fire-place, with charcoal, bones, sherds, etc.
**L** — Layer of surface mould.
**M** — Layer of pottery clay outside of hut.
**N** — Bed of clay (Leda clay) underlying the hut bottoms.

## ARTICLE II.

*Reprint of Article IV. in Bulletin No. III.*

# MAMMALS OF NEW BRUNSWICK.

BY MONTAGUE CHAMBERLAIN.

## INTRODUCTION.

So far as has been ascertained, there have been but two catalogues of the Mammals of this Province previously published; one of these appeared in a work by Abraham Gesner, Esq., issued in 1847, entitled "New Brunswick; with notes for Emigrants, comprehending the early History, etc.;" the other is placed among the appendices to "Field and Forest Rambles," a work on New Brunswick, by Dr. A. Leith-Adams, published in 1873. Neither of these catalogues being correct — when judged by the result of more recent investigations — a new one has been called for, and it is to meet this demand that the present paper is now published.

All of the species mentioned have been identified by the writer, excepting a few otherwise noted in the text; but in deciding upon the relative abundance he has had to depend, to a large degree, upon the opinions of others, and while the best available information has been obtained, it is very probable a difference of opinion may exist regarding the correctness of some of the determinations. A criticism of the catalogue is invited from observers throughout the Province, with a view to having whatever errors it may contain rectified in a future edition.

Want of space prevents his mentioning the names of all the gentlemen who kindly gave the writer the benefit of their observations, and to whom he desires to express his thanks; but he is under especial obligation to Mr. James Vroom, St. Stephen, and to Mr. John Stewart, Woodstock, for valuable notes.

The classification and nomenclature is that of Jordan's "Manual of the Vertebrates," excepting a slight difference in the Bats, copied from Dobson's "Catalogue of the Chiroptera."

## CATALOGUE.

1, **Panther.** (*Felis concolor.*) Dr. Gesner records this species as "rare" (in 1847). No recent instances of its occurrences are known.

2. **Canada Lynx.** "**Loup-cervier.**" "**Loocervee.**" (*Lynx canadensis.*) Common.

3. **Bay Lynx.** "**Wild Cat.**" (*Lynx rufus.*) Common.

4. **Wolf.** (*Canis lupus.*) Was common from about 1840 until about 1860; since then it has entirely disappeared. Dr. Gesner states that Wolves were first seen in New Brunswick in 1818.

5. **Red Fox.** "**Silver Fox.**" "**Black Fox.**" "**Patch Fox.**" "**Cross Fox.**" (*Vulpes vulgaris.*) Abundant.

6. **Sable. Pine Marten.** (*Mustela americana.*) Common.

7. **Fisher. Black Cat.** (*Mustela pennantii.*) Rare.

8. **Least Weasel.** (*Putorius vulgaris.*) Common.

9. **Common Weasel. Ermine.** *Putorius ermineus.*) Common.

10. **Mink.** (*Putorius vison.*) Common.

11. **Wolverine.** (*Gulo luscus.*) Some thirty years ago it was occasionally met with; but no recent instance of its occurrence is known.

12. **Skunk.** *Mephitis mephitica.*) Abundant.

13. **Otter.** (*Lutra canadensis.*) Rather common in favorable localities.

14. **Brown, Black, or Cinnamon Bear.** (*Ursus americanus.*) Common.

15. **Racoon.** (*Procyon lotor.*) Common along the Bay of Fundy coast; but very rare in the interior.

16. **Moose.** (*Alce americanus.*) Not uncommon.

17. **Caribou.** (*Rangifer caribou.*) Common.

18. **Virginia Deer.** (*Cariacus virginianus.*) Uncommon, though increasing. This Deer was formerly restricted to the valley of the Magaguadavic; but has lately spread into other portions of Charlotte and York Counties, and a few have been taken in Carleton and Victoria. There is no

record of any having been observed east of the St. John River. Dr. Gesner states that this species was first seen in New Brunswick in 1818, the same year in which the Wolf appeared, and that by 1847 it had become plentiful.

19. LITTLE BROWN BAT. *Vespertilio subulatus.*) Common.

20. RED BAT. *Atalapha noveboracensis.*) Rare.

21. HOARY BAT. (*Atalapha cinerea.* Uncommon.

22. COMMON MOLE, *Scalops aquaticus.*) Abundant.

23. HAIRY-TAILED MOLE. (*Scapanus brewєri.*) Very rare. I have seen but one specimen, which was taken in Charlotte County.

24. STAR-NOSED MOLE. (*Condylura cristata.*) Common.

25. COMMON SHREW. (*Sorex platyrhinus.*) Common.

26. WESTERN SHREW. (*Sorex cooperi.*) Rare.

25. MOLE SHREW. (*Blarina brevicauda.*) Common.

28. FLYING SQUIRREL. (*Sciuropterus volucella.*) Common.

29. GREY SQUIRREL. (*Sciurus carolinensis.*) A few have been observed in Charlotte and Carleton Counties, near the western border.

30. RED SQUIRREL. *Sciurus hudsonius.* Very abundant.

31. GROUND SQUIRRED. "CHIPMUNK." (*Tamias striatus.*) Common.

32. WOODCHUCK. GROUND HOG. (*Arctomys monax.*) Common.

33. BEAVER. (*Castor fiber.*) Not so numerous as formerly, and now principally restricted to the wilderness portions of the Province, though Mr. Stewart writes to me: "I find the Beaver are coming back to the streams in Carleton and York Counties that have been abandoned by the lumbermen.'

34. JUMPING MOUSE. "WOOD MOUSE." (*Zapus hudsonius.*) Uncommon.

35. BROWN, or NORWAY RAT. (*Mus decumanus.*) Abundant in the towns near the seaboard, and gradually spreading inland along the rivers. On the St. John River, it has been traced as far inland as Grand Falls.

36. BLACK RAT. (*Mus rattus.*) Mr. G. A. Boardman reports finding a few examples near St. Stephen.

37. **House Mouse.** (*Mus musculus.*) Abundant near the seaboard.

38. **Deer Mouse. White-footed Mouse.** (*Hesperomys leucopus.*) Common in the interior.

39. **Long-eared Mouse.** (*Evotomys rutilus.*) Common.

40. **Meadow Mouse.** (*Arvicola riparius.*) Abundant.

41. **Muskrat. Musquash.** (*Fiber zibethicus.*) Abundant.

42. **Porcupine.** (*Erethizon dorsatus.*) Common.

43. **Rabbit. Northern Hare.** (*Lepus americanus.*) Very abundant.

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## MARINE MAMMALS.

**Harbor Seal.** Common.

**Harp Seal.** Occasional, in winter.

**Hooded Seal.** A few have been observed along the Gulf of St. Lawrence coast.

**Porpoise.** Common.

**Whales** have been occasionally reported in the Bay of Fundy and off the "North Shore;" but the species are, for the most part, conjectural.

## ARTICLE III.

## PROTOLENUS — A NEW GENUS OF CAMBRIAN TRILOBITES.

BY G. F. MATTHEW, M.A., F.R.S.C.

Fragments of a trilobite which appeared to be an Olenellus had in past years been found in the beds of Band *b.*, Division 1, of the St. John group, at Hanford Brook, St. Martin's, and in the summer of this year, 1892, I sent my son, W. D. Matthew there, to search for better examples. Though unsuccessful in this quest, he found remains of other forms of trilobites in these lower beds of the Cambrian, which serve to extend our view of the range and variety of the early Cambrian genera. Among these remains were the head-shields and body-joints of the genus herein described.

### PROTOLENUS.* n. gen.

Head-shield semicircular, moderately vaulted, outer part of the cheek movable, prolonged at the genal angle into a spine.

Middle piece of the head more or less quadrate. *Anterior margin* wide and having a narrow distinct fold at the rim. *Glabella* conical or cylindro-conical, prominent, marked by furrows on the sides, and distinct from the occipital ring. *Fixed cheeks* of variable width, bordered by a long, continuous or nearly continuous eyelobe. Extension of the dorsal suture both in front of and behind the eye, more or less direct to the margin.

Movable cheek regularly curved, area wider than the distinct fold, spine usually long.

Thorax of many joints, pleuræ grooved for part of their length, slightly geniculate, curved backward in the distal part, extended into points or spines.

Pygidium in the Canadian species unknown (small ?) ; in the Sardinian species like that of Paradoxides (or of Olenus.)

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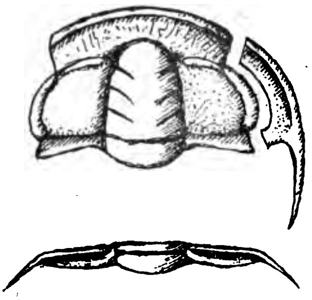
**Protos*, first, *olenus*, as one of the Olenidæ.

PROTOLENUS ELEGANS, (W. D. Matthew, sp. M.S.S.) n. sp.

Head-shield semicircular and more decidedly vaulted than in the succeeding species.

Middle piece oblately subquadrate. *Front Margin* broadly arched, front area sloping down from the glabella and cheeks, and limited by a narrow, well defined marginal fold. *Glabella* prominent, about one quarter longer than wide, marked at the sides by three distinct furrows, directed backward. *Occipital ring* broadly rounded behind, separated from the glabella by a distinct furrow. *Fixed Cheek* broad, subquadrate, bounded in front by a heavy ocular fillet which is broadest at the inner end, where it rises from a depression in the shield on the line of the dorsal furrow. Ocular lobes prominent, long, moderately arched ; suture extending almost directly to the margin, both before and behind the eyelobe. *Posterior Margin* bounded by a narrow fold somewhat geniculated one-third from the end, furrow broad, widening toward the end.



*Protolenus elegans.* Middle piece of the head-shield, the movable cheek and one joint of the thorax. All of the natural size.

Movable cheek with a narrow area, narrow marginal fold, and a long slender spine, arched inward behind, and nearly as long as the body of the cheek.

Thorax of many segments, the joints having a prominent ring, grooved across at the anterior third ; pleura with a broad shallow groove, fading out one-third or one-half from the end of the pleura; the posterior bounding ridge of the pleura is geniculated about one-third from the end of the groove, and the pleura itself is continuous with the anterior bounding ridge and is prolonged into a slender spine.

Pygidium unknown.

*Sculpture* consists of minute shallow pits invisible to the unassisted eye. In one form of the species (perhaps a sexual variety) the slope of the head in front of the glabella and ocular fillet is wider than in the common form, and is ornamented with forking and inosculating raised lines running toward the anterior marginal furrow ; such lines also appear on the surface of the fixed cheek, radiating from its posterior inner corner.

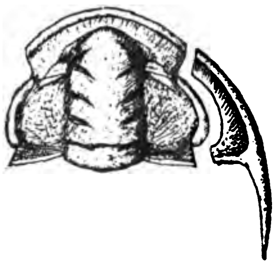
*Size.* Length of middle piece of the head-shield in the variety with wide anterior margin, 22 mm., in the other 20 mm. : width at the front of the middle piece 24 mm., at the eyelobes 28 mm. Length of the movable cheek (including spine) 26 mm. : width at the eyelobe 4 mm., behind it 6 mm.

*Horizon and Locality.* In sandy shales of the upper part of Assise 2 in Band *b.* of Division 1 of the St. John Group, at Hanford Brook.

### PROTOLENUS PARADOXOIDES.[*] n. sp.

Head shield elongate semicircular.

Middle piece subquadrate. *Front Margin* strongly arched in front, arched upward at the contact with the glabella; so that there is a sharp ridge here in place of the usual furrow. *Glabella* nearly a half longer than wide, indented at the sides in front of the eyelobe. There are three pairs of furrows, inclined backward and a trace of a fourth (anterior)furrow,directed forward. *Occipital ring* rounded forward at the back, divided from the glabella by a distinct furrow, which is more deeply impressed in the outer third : there is an obscure tubercle at the centre of the ring.



*Protolenus paradoxoides.* Middle piece of the head-shield, and the movable cheek. Both of the natural size.

*Fixed Cheeks,* ovate, flat, of moderate width and having a pear shaped tubercle opposite the third (anterior) furrow ; this tubercle is oblique to the ocular fillet, which crosses it but is faintly marked. Ocular lobes, distinct, moderately arched, continuous to the posterior marginal furrow. The dorsal suture runs direct to the margin of the shield, both before and behind the eye.

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[*] Contracted for euphony from *paradoxidoides.*

Movable cheek narrow, area somewhat wider than the fold; at the genal angle is a long spine directed backward.

Thorax, only detached joints are known, the pleura is flat with a diagonal furrow extending part of its length.

Pygidium unknown.

*Sculpture.* The area in front of the glabella and ocular fillet is covered with forked and anastomosing raised lines, running toward the anterior marginal fold, and the fixed cheek is decorated with similar lines running from the posterior inner corner, forward and outward. The whole surface of the crust is covered with minute tubercles, visible only with the aid of a lens.

*Size.* Length of the middle piece of the head 21 mm. Width at the front 21 mm., at the eyelobe 27 mm.

*Horizon and Locality.* In purple streaked grey sandstones of Assise 3 in Band *b.* of Division 1, at Hanford Brook, St. Martins.

This species differs from the preceding in the longer, larger, more cylindrical glabella; the narrower, flatter fixed cheek, etc.

The following section of Band *b.* of the Acadian Division 1, of the St. John group will show the stratigraphical position of the genus Protolenus; all the horizons herein named being below the Paradoxides beds.

No. 5. Twenty feet. No trilobite known. The fauna consists chiefly of Brachiopods—Acrothele, Lingulella, etc.

No. 4. Twenty feet. No trilobites. Ostacods of the genus Beyrichona.

No. 3. Thirty feet. Several genera of trilobites—Ellipsocephalus, two or more species, Protolenus (*P. paradoxoides*,) Conocephalites, etc. This is specially the zone of Ellipsocephalus.

No. 2. Fifty feet. In the upper part an Ellipsocephalus different from those in Assise 3 occurs in company with Protolenus (*P. elegans.*) The middle of this assise is specially the home of Protolenus (*P. elegans*) where it is found plentifully with *Beyrichona tinea.* The lower half of the assise has yieldno trilobites but contains Acrothele and other brachiopods.

No. 1. Forty feet. In this coarse sediment the fossils are fragmentary and poorly preserved. Nevertheless a trilobite has been recognized in it, (an *Ellipsocephalus ?*) represented only by a fragment of the head-shield. The ostracod, *Hipponoiharion Eos*, is confined to this assise, and brachiopods of the genera Acrothele, Acrotreta, Linnarssonia and Lingulella have been found.

# APPENDIX A.

## REPORT OF THE COUNCIL OF THE NATURAL HISTORY SOCIETY OF NEW BRUNSWICK FOR 1890.

The Council of the Natural History Society begs to lay before the members a summary of the progress of the society during the past year as collected from the reports of officers and committees.

**ESSAYS AND LECTURE COMMITTEE.** The course of essays and lectures has been carried out as usual and the meetings have been well attended. The following papers or addresses were given by members on the dates mentioned:

| 1890. | |
|---|---|
| FEB. 4th, | Winter Plants.—By G. U. Hay. |
| MAR. 4th, | Surface Geology.—By W. J. Wilson. |
| APR. 1st, | Physiology of Digestive system of Animals.—By Dr. A. F. Emery. |
| MAY 6th, | The Eophyton.—By G. F. Matthew. |
| OCT. 7th, | Archæozoon Acadiense.—By G. F. Matthew. |
| NOV. 4th, | Native Ferns.—By G. U. Hay. |
| DEC. 2nd, | The Human Heart.—By Dr. G. E. Hetherington. |
| 1891 | |
| JAN. 6th, | Post Pleiocene deposits at St. Martins, N. B.—By Geoffrey Stead. |
| JAN. 6th, | How the Natural History Society could assist in Education —By John Brittain. |

**FINANCE COMMITTEE.** The Finance Committee report that the

| | |
|---|---|
| Treasurer has a balance on hand of | $102.77 |
| The balance on hand at beginning of year was | 250.04 |
| The receipts for year amounted to | 427.78 |
| And the disbursements to | 575.05 |

The acquiring and removing to our rooms, of the Mechanics Institute Museum, necessitated a large expenditure.

**LIBRARIAN.** The Library has received numerous additions consisting chiefly of reports from other societies.

CURATORS. The additions to the Museum referred to called for several changes in the arrangement of specimens in the various rooms. The minerals and fossils have been moved to the large room at the top of the building, to make room for the various collections down stairs. The minerals from the Mechanics' Institute have been arranged temporarily in their own cases, but much work remains to be done to incorporate them with our former collections. A list of the benefactors who have contributed to the museum during the year will be read in connection with this report.

GEOLOGICAL COMMITTEE. The Committee on Geology make no very lengthy report as no concerted work in that department has been undertaken during the past year. The work done by the President, however, in connection with the fossils in the Laurentian Limestone near St. John, as described by him in papers read before this society, and published in the last issue of our Bulletin is of importance, especially as it may help to settle the much debated question whether the objects found in these old rocks are of animal origin or not. The discovery in the Post Pleiocene at St. Martins, of two fossils new to Canada, by another member of the society (Mr. G. Stead) is also worthy of mention. The committee recommends that during the coming year some special work in the study of local geology should be attempted, either by the revival of the field club, summer camps, or other means which would enlist the sympathy and co-operation of the largest possible number of members.

COMMITTEE ON BOTANY. The Botanical Committee make the following provisional report: The members of this committee, with other botanists interested in the investigation of our local flora, have discovered over a dozen species of plants new to our province. The additions to our flora show that the interest among our students is still active. The committee hope that the study of plants will receive yet more attention, especially mosses, fungi and lichens, which are yet imperfectly known.

PUBLICATION COMMITTEE. The ninth Bulletin of our society has been issued, and copies sent to the members. It contains a sketch of the life of Professor Charles F. Hartt, who was a life member of our society and one of its founders. It also contains the President's annual address and two short geological articles by the same writer. Mr. W. F. Ganong has contributed in this number, his notes on the marine animals of the Bay of Fundy.

The council would add that the question of having a more suitable building, and one owned by the society, has been before them. They trust that this most desirable object may be promoted in every way possible, by all who have an interest in natural history and especially in the preservation of the many and valuable specimens now in their charge, and continually coming into the museum.

The council desires to thank all who have aided in the work of the society, and the city press for the regular insertion of notices of meetings during the year.

Respectfully submitted,
J. ROY CAMPBELL,
*Secretary to Council.*

# DONATIONS TO THE MUSEUM.

| DATE. | DONOR'S NAME AND DESCRIPTION OF ARTICLE. |
|---|---|
| 1890<br>Feb. 21 | W. F. HATHEWAY. — Fossil bones from phosphate beds, Florida. |
| | G. F. MATTHEW.—Tracks of marine animals (*Eoichnites*, etc.,) from Div, 2, St. John Group. |
| Mar. 7 | KILGOUR SHIVES, Campbellton. — Chrysalis of a large moth, Dunsinane, Kings Co. |
| 21 | CHARLES E. BUNTING, British Columbia.—Two wooden idols, from Sitka. Fish and Birds' nests, prepared for cooking, Rice cake, Opium for smoking and pipe bowls, Chinese charm and hair ornaments, and advertisements, Plate of a turtle, all from China. |

## DONATIONS TO THE MUSEUM—(*Continued*).

| DATE. | DONOR'S NAME AND DESCRIPTION OF ARTICLE. |
|---|---|
| 1890<br>Apr. 1 | W. W. Street.—Partridge, mounted. |
| June 17 | Mrs. Stewart, St. John.—Neuropterous insect. |
| | Andrew Smith, St. John.—Large moth. |
| | Wm. Murdock, C. E.—Slab of marble, composed of crowded fossils (*Archæozoon*). Grêen Head, St. John Co. |
| Aug. 1 | Prof. W. F. Ganong, Cambridge, Mass. —Three species of Sponge, eight species of Radiates, two species of Hydroids, eight species of Articulates, three species Eggs of Vertebrates, sixty-two species of Mollusca, also Echinoderms, Polyzoa, Worms and Ascidians in alcohol—all marine invertebrates of the Bay of Fundy. |
| Oct. 6 | R. E. Gosnell, Commissioner for Exhibition from British Columbia. — Two large plants (wild Raspberry and Huckleberry) two Echinoderms, one Coral (*Oculina*), four Molluscs (*Modiola*, *Fusus*, *Pecten*, *Patella*). Kelp fishing line used by the natives—all from British Columbia. |
| Nov. 4 | R. P. Starr.— Rare plant of the coal measures, (*Knorria*) Springhill, N. S. |
| | Miss M. E. Stewart, St. Stephen, N. B.—Barnacle (*Balanus*) and sea moss, and large tree cone — California. |
| | Austin Stead. — Violet (*Viola primulifolia*), Lily Lake, St. John. |
| Nov. 4 | H. F. Perkins.—Moonwort (*Botrychium matricarifolium*), and Adder's tongue fern (*Scolopendrum vulgare*). Clarendon, Charlotte Co. |
| 5 | E. C. Jones.—Fossil fern (*Neuropteris*), Chamounix, Switzerland. |
| Dec. 2 | Rev. J. M. Davenport.— Various seeds and nuts from Trinadad, British West Indies; crude isinglass from Oronoco River. |
| | Mrs. P. S. Bowden. — Mollusc (*Ptericola pholadiformis*), Parrsboro, N. S. |

# DONATIONS TO THE LIBRARY.

| Date. | Donor's Name and Description of Book. |
|---|---|
| 1890<br>Feb. 4 | The Author.—Six pamphlets on Geology of Belgium; Biographical notices, Parts I. to IV.; Cretaceous System in Belgium, Parts I. to IV., by H. Forir, Liege, Belgium. |
| | Kongl. Svenska veterskaps akademie.—Memoirs, Vol. 13, Nos. 1 to 4; Bulletin, No. 44 and 45. |
| | Natural History Society, Montreal.—Vol. III., Nos. 7 and 8; Vol. IV., Nos. 1, 2, 3, 4. |
| 6 | U. S. National Museum.—Bulletins Nos. 33 to 37; Proceedings, Vols. X. and XI. |
| 10 | The Author.—New plants from the Erian and Carboniferous, by Sir J. W. Dawson. |
| 18 | Director Geological and Natural History Survey, Ottawa.—Catalogue of Canadian Plants. Part V. List of Canadian Hepaticæ. Annual Report, N. S., Vol. III., Parts I. and II., with maps of Asbestos area and of N. E. New Brunswick. |
| | Feuille des Jeunes Naturalistes.—Proceedings, Nos. 232 to 242. Catalogue No. 8 and 10. |
| Mar. 7 | Belfast Naturalists Field Club.—Proceedings. Series II. Vol. III., Part II., Part III. |
| Apr. 1 | Canadian Institute, Toronto.—Annual Report, 1889. Proceedings, 3rd series; Vol. VII.; Fasc. 2. |
| | E. Gilpin, C. E., Halifax. — Quarterly Journal Geological Society, London, Nos. 181, 184. |
| | Dr A. F. Emery.—Animal Physiology, by Dr. Wesley Mills. |
| May 1 | Academy of Natural Sciences, Philadelphia.—Proceedings, 1889, Part III.; 1890, Parts I. and II. |
| | N. Y. Microscopical Society.—Journal, Vol. VI., Nos. 2, 3, 4. |
| | Société R. Malocologique de Belgique, Brussels.—Proceedings, July, 1888 to July, 1889; January to July, 1885. |
| | U. States Fish Commission, Washington.—Report, 1887. |

## DONATIONS TO THE LIBRARY.—(*Continued*).

| DATE. | DONOR'S NAME AND DESCRIPTION OF ARTICLE. |
|---|---|
| 1890<br>May 1 | Ottawa Field Naturalists Club.—Vol. III., No. 4; Vol. IV., Nos. 1, 2, 3, 4, 5, 6, 7, 8. |
| | Elisha Mitchell Scientific Society, Chapel Hill, N. C.—Journal, Vol. IV., Part 2nd. |
| | The Author.—List of North American Noctuidæ, Part I., by A. R. Grote. |
| | Washburn College, Topeka, Kan.—Bulletin of Laboratory, Vol. II., No. 2. |
| | American Museum of Natural History, New York.—Bulletin, Dec. 1889 and Feb. 1890. Report, 1889–90, Vol. III., No. 1, and pp. 117-122. |
| | Essex Institute, Salem.—Bulletin, Vol. XXI., Nos. 7, 8, 9, 10, 11, 12; Vol. XXII., Nos. 1, 2, 3. |
| 13 | Sir J. W. Dawson.—Postpleiocene flora of Canada. |
| | Dr. L. C. Allison.— Description of 300 animals, pub. 1719. |
| June 1 | Minnesota Academy of Natural Sciences, Minneapolis.—Bulletin, 1889. |
| | Commissaõ geographica e geologica da S. Paulo, Brazil.—Boletin, 1887, 1888, 1889; Nos. 1 and 2. |
| | The Author.—Os picos altos do Brazil, by O. A. Derby. |
| July 15 | Director British Museum, London.—Guide to Exhibition Galleries, Parts I. and II. |
| | Linnean Society, New York.—Abstract, 1889–90. |
| | Newport Natural History Society.—Proceedings, 1883, 1883–4, 1884–5, 1885-6, 1886-7, 1887-8. |
| | Smithsonian Institution, Washington. — Report National Museum, 1886, Part II., 1887; 1887, Report of Director. Bulletin U. S. National Museum, No. 38, Proceedings, Vol. XII., 1889. Report, 1883. |
| | U. States Geological Survey, Washington.—Ninth Report, 1887-8—Monograph of L. Bonneville, Gilbert—Mineral resources, 1888, Day— Bulletins 58 to 64 and 66. Annual Report, 1886–7, Parts I. and II. Bulletins Nos. 55 to 57, Monographs XV. and plates (2 vols.), XVI. (1 vol.) |

## DONATIONS TO THE LIBRARY.—*(Continued).*

| DATE. | DONOR'S NAME AND DESCRIPTION OF ARTICLE. |
|---|---|
| 1890<br>July 28 | GEOLOGICAL SOCIETY, London.—Abstract, Nos. 544–560. |
| Aug. 8 | ROYAL SOCIETY OF CANADA, Ottawa.—Transactions, Vol. VII. |
| Oct. 1 | THE AUTHOR.—Bibliography of North American Palæontology for 1886, by J. B. Marcou. |
| | NATURAL HISTORY SOCIETY, Trenton, N. J.—January, 1886. |
| | U. STATES DEPARTMENT OF AGRICULTURE, Washington.—North American fauna, No. 3. |
| 20 | BOSTON SOCIETY OF NATURAL HISTORY.—Proceedings, Vol. XXIV., Parts III. and V. |
| Nov. 4 | VEREIN FÜR ERDKUNDE, Leipzig.—Mitteilungen, 1889. |
| | G. F. MATTHEW.—Sixth Annual Report of State Geologist, New York. |
| | THE AUTHOR.—Natural Resources of British Columbia, by R. E. Gosnell; Mineral Resources of British Columbia, by D. Oppenheimer. |
| 11 | COLORADO SCIENTIFIC SOCIETY, Denver.—Proceedings, Vol. III., Part II. |
| 25 | THE AUTHOR.—Lower and Middle Taconic of Europe and North America, by Jules Marcou. |
| Dec. 2 | SANTA BARBARA SOCIETY OF NATURAL HISTORY.—Bulletin, Vol. I., No. 2. |

N. B.—The Library Committee wish to remind members of the Society that the rooms are open for the issue of books on Tuesday evenings at 7.30. The committee hope that members who have the opportunity to do so will use their endeavours to add to the library by donations or otherwise. There must be in the city numbers of books and magazines on Natural History, the owners of which having read them, would find them more useful in this collection than on the shelves of a private library. Several donations of this kind have been received in past years, and found useful, and any further gifts will be gladly acknowledged.

# OFFICERS AND COMMITTEES OF THE NATURAL HISTORY SOCIETY FOR 1890.

*Patron* — His Honor Sir S. L. Tilley.

## COUNCIL FOR 1890.

*President* — Geo. F. Matthew, M. A., F. R. S. C.
*Vice-Presidents* — Geo. U. Hay, Ph. B., R. Penniston Starr, Esq.
*Treasurer* — Alfred Seely, Esq.
*Corresponding Secretary* — G. Ernest Fairweather.
*Recording Secretary* — J. Roy Campbell.
*Librarian* — S. W. Kain.
*Curators* — W. J. Wilson, Jas. A. Estey, Wm. Murdock.
*Additional Members* — Thos. Stothart, W. F. Best, Edwin Fisher.

## STANDING COMMITTEES FOR 1890.

*Physics and Chemistry* — W. F. Best, G. U. Hay.
*Meteorology* — G. Murdock, W. F. Best, W. Murdock.
*Geology* — W. J. Wilson, G. F. Matthew, L. W. Bailey.
*Botany* — G. U. Hay, J. Brittain, H. F. Perkins.
*Entomology* — J. Brittain, Mrs. C. E. Heustis.
*Invertebrates* — W. F. Ganong, S. W. Kain, G. Stead.
*Fishes and Reptiles* — P. Campbell, S. W. Kain, W. G. Harding, M. D.
*Ornithology* — T. W. Daniel, A. Morrissey, P. Cox.
*Library* — S. W. Kain, Misses Knowlton and F. Murray, G. E. Fairweather, T. Stothart, G. F. Matthew, G. U. Hay.
*Essays and Lectures* — G. F. Matthew, G. U. Hay, J. A. Estey, E. Fisher, J. Montgomery, W. J. Wilson, J. R. Campbell.
*Publications* — G. F. Matthew, G. U. Hay, A. Seely, W. F. Best, G. E. Fairweather.
*Rooms* — G. E. Fairweather, W. J. Wilson, G. F. Matthew, P. Hall.
*Finance* — A. Seely, E. Fisher, J. R. Campbell.
*Press* — G. U. Hay, G. E. Fairweather, G. F. Matthew, S. W. Kain.

# APPENDIX B.

## REPORT OF THE COUNCIL OF THE NATURAL HISTORY SOCIETY OF NEW BRUNSWICK FOR 1891.

The Council of the Natural History Society desires, in accordance with the provisions of the constitution, to present to the society their annual report for the past year.

FINANCE. The Treasurer's report shows the following:

| | |
|---|---|
| Balance on hand from last year | $103.08 |
| Dues collected | 75.00 |
| Bulletins sold | .30 |
| Provincial Grant | 125.00 |
| | $303.38 |
| Expenditures | 126.04 |
| Balance on hand | $177.34 |

ESSAYS AND LECTURES. During the year past, eight regular meetings have been held and the following papers or lectures were delivered on the dates named.

| 1891. | |
|---|---|
| FEB. 17th, | Chemistry of the Six Days of Creation.—By W. B. McVey. |
| MAR. 3rd, | Silent Language of the Muscles.—By Dr. Foster McFarlane. |
| MAY 5th, | On Sugar.—By W. F. Best. |
| DEC. 1st, | Dictyomena, or the Tread-net Bell of the Cambrian seas. —By G. F. Matthew. |

In the month of June a very successful and largely attended Field Meeting was held at Pisarinco and vicinity. Among those who led research parties during the day were Dr. Bailey and Mr. John Brittain of Fredericton, and Mr. J. Vroom of St. Stephen.

At the regular meeting on October 6th, at the invitation of the council, addresses were delivered by the Rev. George Bruce, Dr. I. Allen Jack and Dr. A. A. Stockton on the work and object of the proposed University Extension Course, and in accordance with the resolutions of the Society, the council assisted the committee in charge of the course, in forwarding the movement. A number of these lectures have been delivered in the rooms of the society.

GEOLOGICAL COMMITTEE. Some additions to our museum during the past year to which this committee might refer are of interest as helping to complete the series of fossils of the St. John group. One of these the well known *Dictyonema flabelliforme*, an animal of wide distribution in the Cambrian seas, and of value in fixing a definite age for the rocks in which it is contained. This was discovered last spring at Navy Island by one of our members, Mr. G. Stead. With the discoveries of fossils previously made in different parts of the St. John group, that group has now become the most complete standard of comparison for the several successive faunas (assemblages of animals) of the Cambrian age in eastern North America.

BOTANICAL COMMITTEE. This committee report that many new plants, some twenty in number, have been found in New Brunswick since they made their last report. The committee will endeavour to prepare a list of them for publication in the Bulletin.

LIBRARY. Beside a number of presentations to the library the usual exchanges for the Society's Bulletin, and reports from other societies have been received.

MUSEUM. Numerous and valuable additions to the museum have been made during the year. The work of classifying and mounting the botanical collections has been continued by the custodian.

The council wish to express their thanks to those gentlemen who have delivered lectures or addresses before the society, to the donors and benefactors, and also to the daily press for the inserting of preliminary notices of meetings.

Respectfully submitted,

J. ROY CAMPBELL,
*Secretary to Council.*

## REPORT OF THE GEOLOGICAL COMMITTEE.

The Geological Committee would submit the following report on the palæontology of the Cambrian rocks at St. John.

### LIST OF THE FOSSILS FOUND IN THE CAMBRIAN ROCKS IN AND NEAR ST. JOHN, BY G. F. MATTHEW, M. A., F. R. S. C.

As the study of the organic remains found by the author and others in the Cambrian rocks around St. John is now nearly finished, it is possible to give a list of these remains, showing the zoological standing of the species and the various horizons at which they have been found.

In order to make the catalogue more useful for reference, a brief description is given of the rocks of the several levels at which the fossils were found.

These rocks are divisable into two series, there being a break in the succession of the beds at the top of the Basal Series, where its upper beds have been considerably worn to furnish material for the lowest beds of the next series, the St. John Group.

Although we make two divisions in the lower series, we have not ventured to call them stages, as the faunas, so far as known, are not sufficiently distinct to make it advisable. We therefore regard this as one stage.

### BASAL SERIES OF ROCKS OR ETCHEMINIAN STAGE.

The section at Hanford Brook is one of the clearest known for this series, and from the base upward is as follows (all the following sections are ascending):

| | | | Thickness in feet. |
|---|---|---|---|
| DIV. 1. | *a* | Coarse purplish red conglomerate,................. | 60 |
| | *b* | Grey and purplish flags, shales and sandstones,..... | 70 |
| | *c* | Purplish red sandstones with greenish layers,....... | 240 |
| DIV. 2. | *a* | Purplish red conglomerate, more friable than 1 *a*,.... | 35 |
| | *b* | Soft purplish red slates with greenish glauconite grains, the upper part firmer and more sandy; greenish grey layers interspersed, especially toward the base,... | 175 |
| | *c* | Purplish sandy shales, with a few bands of greenish shale,.... ........... ............................ ... | 300 |
| | | Space without exposures,....... ..................... | 320 |
| | | | 1.200 |

Other good exposures of this series are found at Ratcliff's, Millstream, Simonds, and at Caton's Island on the Long Reach of the St. John River.

### St. John Group (Acadian Group, Dawson.)

This series is much more important for its faunas than the preceding, and for this reason is divided into three stages.

*Division 1, or Acadian Stage.*—A section at the north end of St. John (at Seely street) gives the following succession :

| | Thickness in feet. |
|---|---|
| *a* Coarse grey sandstone, or quartzite, | 50 |
| *b* Coarse grey sandy shale. (Zone of *Agraulos articephalus*), | 50 |
| *c* Fine grey and dark grey shales, with calcareous nodules. (Zone of *Paradoxides Eteminicus*), | 25 |
| *d* Fine dark grey carbonaceous shales. (Zone of *Paradoxides Abenacus*), | 75 |
| | 200 |

This division is also visible on the south side of the St. John Basin, at the shore of Courtney Bay, near the Alms House, where its thickness is three times as great as at Seely Street; the increase is mostly in Section *d*. It also crosses the city from Duke street and Mecklenburg street on the east, to Lower Cove slip on the west; here it is no longer visible, partly because it has been eroded and partly because of the filling in of streets. On the western side of the harbour it occupies part of the Mill Pond in Carleton, and extends up the valley south of King's Square, to the west of the Mill Pond.

*Division 2, or Johannian Stage.*—This is a very prominent member of the St. John Group in the Old City and in Carleton, or West End. Also in Portland, or North End, there is a good exposure at Wright Street, where the following measured section was made :

| | Thickness in feet. |
|---|---|
| *a* Dark grey slates with thin seams of grey sandstone, | 220 |
| *b* Coarse grey slate and grey flagstone, the flags predominating. (Zone of *Lingulella Starri*). | 300 |
| *c* Grey flagstone and grey slate in frequent alternations. (Zone of *Lingulella radula*), | 230 |
| | 750 |

In the centre of the St. John Basin the thickness of this division, especially of its upper part (Section *c*), is greatly increased. The whole division there counts about 1,000 feet of measures. It is visible on the east side of Courtenay Bay, from its head to the Alms House brook. In the Old City it forms a broad belt across the centre, bounded on the north by a line from Union street east, to the Carleton Ferry, and on the south by one from Orange street east, to Reed's Point. On the west side of the harbour it rises prominently into a ridge at King's Square, south of which its width extends for the space of one block (or square).

*Division 3, or Bretonian Stage.*—This division includes at the summit a small thickness of beds, which belong to the Ordovician system; but although not Cambrian, they form a part of the St. John Group, and are therefore included in this statement.

The Bretonian consists entirely of fine shales of dark color, much of it being intensely black and carbonaceous. It contains three faunas and so marks the passage of a long interval of time.

| | | Thickness in feet. |
|---|---|---|
| *a* | Black shales alternating with dark grey shales, and having calcareous nodules. (Zone of *Parabolina spinulosa*),... | 100 ? |
| *b* | The same as the last, but finer. (Zone of *Peltura scarabeoides*), | 100 ? |
| *c* | Black carbonaceous shales. (Zone of *Dictyonema flabelliforme*), | 300 |
| ? | Same as the last, fauna unknown,........ ............ ... | 175 ? |
| *d* | Similar shales with a few sandy seams. (Zone with *Tetragraptus quadribranchiatus*),... ... .... ....... .. | 25 ? |
| | | 700 |

These soft rocks lie in the valley along the boundary line between the Old City and Portland (" South End and North End,") and extend thence through the harbour to the " Falls " of the St. John River where their thickness is seven hundred feet. Another belt of the rocks of this division extend across the city from Market Square and Water street north, to St. David's street on Courtenay Bay. The rocks of this division always occupy low land, except on the south side of " the valley," where they rise on its southern flank, crossing Jeffrey's Hill, and extending to the City Hospital, etc.

Thus, of Cambrian rocks in the St. John Basin, taking the measurements where the structure is not too much complicated by faults and folds, and where the several members attains their greatest thickness, we have the following :

| | Thickness in feet. |
|---|---|
| Basal Series (Etcheminian) at Hanford Brook, St. Martins. | 1,200 |
| Division 1 (Acadian) at the Alms House, Simonds,...... | 650 |
| Division 2 (Johannian) at King's Square, Carleton,....... | 1,000 |
| Division 3 (Bretonian) at Straight Shore, Portland,...... | 700 |
| | 3,550 |

The thickness of Division 2 is probably greater in the city than in Carleton ; it appears to be 2,000 feet, but there are no doubt folds in the beds, not easily detected, that produce this great apparent thickness.

Probably the whole thickness measured, where the several divisions show the greatest bulk, and including the Basal Series, would not fall far short of 4,000 feet.

This is not equal to the thickness of the Welsh Cambrian rocks which is greatly increased by intercalated beds of volcanic ashes, etc.

The faunas, or assemblages of animals in the St. John rocks, as shown by their remains, exhibit a remarkably close resemblance to those of Cambrian rocks around the Baltic Sea, though separated from them by the wide Atlantic. On the other hand they have very little resemblance to the Cambrian faunas of the interior of America, though only a few hundred miles lie between.

In the following table the species in each genus are arranged generally in the order of their antiquity, and the following abbreviations are used:— v=variety; sp.=species; r=rare; cf=compare with; nar=narrow. Also for authors:

Htt. = C. F. Hartt.
Dn. = Sir J. W. Dawson.
Dav. = T. Davidson.
Salt. = J. W. Salter.
Hick. = Hy. Hicks.
Walc. = C. D. Walcott.
L. = Linnæus.
Ang. = Angelin.
Brög. = Brögger.
Eich. = Eichwald.
Pand. = Pander.
Wahl. = Wahlenberg.
Lins. = J. Linnarsson.

Where no reference is given the species have been described by the author in the volumes of the transactions of the Royal Society of Canada, or are unpublished. To the latter category belong Nos. 22,25,27,35,36,64*a* and *b*,67,77,78,79,137,140,146.

### FOSSILIFEROUS HORIZONS OF THE CAMBRIAN ROCKS AT ST. JOHN, INCLUDING THE ARENIG HORIZON AT THE SUMMIT OF THE ST. JOHN GROUP.

| | Basal Series | | SAINT JOHN GROUP. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Division 1. | Division 2. | DIVISION 1. | | | | | DIV. 2 | | | DIVISION 3. | | | | | |
| | | | *a* | *b* | *c*¹ | *c*² | *d* | *a* | *b* | *c* | *a* | *b* | *c*¹ | *c*² | ? | *d* |
| **Algæ—** | | | | | | | | | | | | | | | | |
| 1 Buthotrephis antiqua Brongiart, sp. | * | | | | | | | | | | | | | | | |
| 2 Palæochorda setacea | * | | | | | | | | | | | | | | | |
| 3 Hydrocytium silicula | | | | * | | | | | | | | | | | | |
| 4 Microphycus catenatus | | | | * | | | | | | | | | | | | |
| **Protozoa—** | | | | | | | | | | | | | | | | |
| 5 Monadites globulosus | * | | | | | | | | | | | | | | | |
| 6 M.——pyriformis | * | | | | | | | | | | | | | | | |
| 7 M.——urceiformis | * | | | | | | | | | | | | | | | |
| 8 Radiolarites ovalis | * | | | | | | | | | | | | | | | |
| **Spongida—** | | | | | | | | | | | | | | | | |
| 9 Plocoscyphia (?) perantiqua | * | | | | | | | | | | | | | | | |
| 10 Astrocladia (?) elongata | | | | * | | | | | | | | | | | | |
| 11 A.—— (?) elegans | | | | * | | | | | | | | | | | | |
| 12 A.——(?) virguloides | | | | * | | | | | | | | | | | | |
| 13 Archæocyathus (?) pavonoides | | | | | * | | | | | | | | | | | |
| 14 Hyalostelia minima | * | | | | | | | | | | | | | | | |
| 15 Dichoplectella irregularis | * | * | | * | | | | | | | | | | | | |
| 16 Protospongia (?) minor | | | | | * | | | | | | | | | | | |
| 16*a* v. distans | | | | | | | * | | | | | | | | | |
| 17 P.—— sp. ? | | | | | | | | | | | | | | | | * |
| **Echinodermata—** | | | | | | | | | | | | | | | | |
| 18 Platysolenites antiquissimus, Eich. | | * | | | | | | | | | | | | | | |
| 19 Eocystites primævus, Bill. | | | | | * | *r | | | | | | | | | | |

FOSSILIFEROUS HORIZONS, ETC.—(*Continued.*)

| | Basal Series | | SAINT JOHN GROUP. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Division 1. | Division 2. | Division 1. | | | | | Div. 2. | | | Division 3. | | | | | |
| | | | *a* | *b* | $c^1$ | $c^2$ | *d* | *a* | *b* | *c* | *a* | *b* | $c^1$ | $c^2$ | ? | *d* |
| **Hydrozoa—** | | | | | | | | | | | | | | | | |
| 20 Dendrograptus (?) primordealis | | | | | | | * | | | | | | | | | |
| 21 Protograptus alatus | | | | | | | * | | | | | | | | | |
| 22 Bryograptus patens, | | | | | | | | | | | | * | | | | |
| 23 Dictyonema flabelliforme, Eich., sp. | | | | | | | | | | | | | | | | |
| v. acadicum | | | | | | | | | | | | * | * | * | | |
| v. confertum, Linrs. ? | | | | | | | | | | | | * | * | | | |
| 24 v. norvegicum Kjeruf, sp. ? | | | | | | | | | | | | | * | * | | |
| 25 D.——delicatulum Dn. var. | | | | | | | | | | | | | | | | * |
| 26 D——quadrangularis Hall | | | | | | | | | | | | | | | | * |
| 27 Clonograptus spinosus | | | | | | | | | | | | | | | | |
| 28 C.——flexilis, Hall | | | | | | | | | | | | * | | | | * |
| 29 Loganograptus Logani, Hall | | | | | | | | | | | | | | | | * |
| 30 Tetragraptus quadribranchiatus, Hall | | | | | | | | | | | | | | | | * |
| 31 T.—— sp. ? | | | | | | | | | | | | | | | | * |
| 32 Didymograptus nitidus, Hall | | | | | | | | | | | | | | | | * |
| 33 D.—— patulus, Hall | | | | | | | | | | | | | | | | * |
| 34 D.——indentus, Hall | | | | | | | | | | | | | | | | * |
| 35 D.——nar. threadlike | | | | | | | | | | | | | | | | * |
| 36 D.——sp. ? very nar. | | | | | | | | | | | | | | | | * |
| 37 Retiograptus tentaculatus, Hall ? | | | | | | | | | | | | | | | | * |
| **Brachiopoda—** | | | | | | | | | | | | | | | | |
| 38 Obolus major | | * | | | | | | | | | | | | | | |
| 39 O.——(Botsfordia) pulcher | | | | * | | | | | | | | | | | | |
| 40 O.——refulgens | | | | | | | | | | | *? | * | * | * | | |
| 41 Obolella (?) gemmula | | | | | | | | | | | | | | * | | |
| 42 Linnarssonia transversa, Htt. | | | | * | | * | * | | | | | | | | | |
| 43 L.——misera, Bill. | | | | | | | * | | | | | | | | | |
| 44 L.——Belti, Dav. | | | | | | | | | | | | | | * | | |

FOSSILIFEROUS HORIZONS, ETC.—(*Continued.*)

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Division 1. | Division 2. | DIVISION 1. | | | | | DIV. 2. | | | DIVISION 3. | | | | | |
| | | | *a* | *b* | $c^1$ | $c^2$ | *d* | *a* | *b* | *c* | *a* | *b* | $c^1$ | $c^2$ | ? | *d* |
| **Brachiopoda**— *Cont'd* | | | | | | | | | | | | | | | | |
| 45 Lingulella Martinensis | | | | * | | | | | | | | | | | | |
| 46 L.——(?) inflata | | | | * | | | | | | | | | | | | |
| 47 L.——Dawsoni | | | | | * | * | * | | | | | | | | | |
| 48 L.——linguloides | | | | | | | * | | | | | | | | | |
| 49 L.——Starri | | | | | | | | | * | | | | | | | |
| 50 L.——radula | | | | | | | | | | * | | | | | | |
| 51 L.——lævis | | | | | | | | | | | * | | | | | |
| 52 L.——lepis, Salt.? | | | | | | | | | | | * | | | | | |
| 53 L.——Nicholsoni, Dav.? | | | | | | | | | | | | * | * | | | |
| 54 Acrotreta, Baileyi | | | | *? | | * | | | | | | | | *? | | |
| 55 —— Gulielmi | | | | | * | | | | | | | | | | | |
| 56 Acrothele Matthewi, Hartt, sp. | | | | *? | * | * | | | | | | | | | | |
| 56*a* v. prima | | | | * | | | * | | | | | | | | | |
| 56*b* v. lata | | | | * | * | *? | | | | | | | | | | |
| 57 Kutorgina Latourensis | | | | | | * | | | | | | | | | | |
| 58 K.—— pterineoides | | | | | * | | | | | | | | | | | |
| 59 Orthisina (?) Billingsi Hartt, sp. | | | | | | * | | | | | | | | | | |
| 60 O. —— (?) quacoensis | | | | | | * | * | | | | | | | | | |
| 61 O.——(?) Johannensis | | | | | | | | | | | * | | | | | |
| 62 Orthis lenticularis, Wahl., sp. | | | | | | | | | | | * | | | | | |
| 62*a* v. lævis, | | | | | | | | | | | * | | | | | |
| 62*b* v. atrypoides | | | | | | | | | | | * | | | | | |
| 62*c* v. lyncioides | | | | | | | | | | | * | | | | | |
| 62*d* v. strophomenoides | | | | | | | | | | | * | | | | | |
| 63 O——Carausii, Hick? | | | | | | | | | | | * | | | | | |
| 64 O.—— electra, Bill. | | | | | | | | | | | | | | | | |
| 64*a* v. major | | | | | | | | | | | | | | | | * |
| 64*b* v. lævis | | | | | | | | | | | | | | | | * |
| 65 O.——orthambonites, Pand., sp. | | | | | | | | | | | | | | | | * |
| 66 O——Euryone, Bill.? | | | | | | | | | | | | | | | | |
| 67 O.—— Clytie, Hall, v. acadica | | | | | | | | | | | | | | | | * |
| 68 Strophomena atava | | | | | | | | | | | | | | | | * |
| 69 Camarella parva, Bill.? | | | | | | | | | | | * | | | | | |

### FOSSILIFEROUS HORIZONS, ETC.—(*Continued.*)

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| | | | *a* | *b* | $c^1$ | $c^2$ | *d* | *a* | *b* | *c* | *a* | *b* | $c^1$ | $c^2$ | ? | *d* |
| **Pteropoda—** | | | | | | | | | | | | | | | | |
| 70 Hyolithes Billingsi Walc. (?) | | * | | | | | | | | | | | | | | |
| 71 H. —— Danianus | | | | | | * | * | | | | | | | | | |
| 72 H.——gracilis | | | | | | | * | | | | | | | | | |
| 73 H.——micmac | | | | | * | * | * | | | | | | | | | |
| 74 H.——(short, broad) | | | | | | | * | | | | | | | | | |
| 75 Diplotheca Hyattiana | | | | * | | *? | | | | | | | | | | |
| 75*a* v. caudata | | | | | | | * | | | | | | | | | |
| 76 D.——Acadica | | | | | | | * | | | | | | | | | |
| 76 v. sericea | | | | | | | * | | | | | | | | | |
| 76 v. obtusa | | | | | | * | | | | | | | | | | |
| 76 v. crassa | | | | * | | | | | | | | | | | | |
| 77 Cyrtotheca minuta· | | | | | | | | | | | | | | | | * |
| 78 C.——corrugata | | | | | | | | | | | | | | | | * |
| 79 Styliola primæva | | | | | | | | | | | | | | | | * |
| **Gasteropoda—** | | | | | | | | | | | | | | | | |
| 80 Parmophorella Acadica, Hartt, sp. | | | | | * | * | | | | | | | | | | |
| 81 Harttia Matthewi, Walc. | | | | | | * | | | | | | | | | | |
| 82 Platyceras aperta | | | | | * | | | | | | | | | | | |
| **Cephalopoda—** | | | | | | | | | | | | | | | | |
| 83 Volborthella tenuis, Schmidt | | * | | * | | | | | | | | | | | | |
| 84 Orthoceras, sp.? | | | | | | | | | | | | | | | | * |
| **Ostracoda—** | | | | | | | | | | | | | | | | |
| 85 Hipponicharion Eos | | | | * | | | | | | | | | | | | |
| 86 Beyrichona papilio | | | | * | | | | | | | | | | | | |
| 87 B.——tinea | | | | * | | | | | | | | | | | | |
| 88 Primitia Acadica | | | | | * | | | | | | | | | | | |
| 89 Isochilina (?) ventricosa | | | | * | | | | | | | | | | | | |
| 90 I.——(?) Steadi | | | | * | | | | | | | | | | | | |

FOSSILIFEROUS HORIZONS, ETC.—(*Continued.*)

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| | Division 1. | Division 2. | DIVISION 1. | | | | | DIV. 2. | | | DIVISION 3. | | | | | |
| | | | *a* | *b* | $c^1$ | $c^2$ | *d* | *a* | *b* | *c* | *a* | *b* | $c^1$ | $c^2$ | ? | *d* |
| **Phyllopoda—** | | | | | | | | | | | | | | | | |
| 91 Stenotheca concentrica | | | | | | | * | | | | | | | | | |
| 91*a* v. radiata | | | | | * | | * | | | | | | | | | |
| 92 S.——Hicksiana | | | | | | | * | | | | | | | | | |
| 93 S.——nasuta | | | | | | * | | | | | | | | | | |
| 94 S.——triangularis | | | | | | * | * | | | | | | | | | |
| 95 Lepiditta alata | | | | | | * | | | | | | | | | | |
| 96 L.——curta | | | | | | | * | | | | | | | | | |
| **Trilobita—** | | | | | | | | | | | | | | | | |
| 97 Agnostus regulus | | | | | * | | | | | | | | | | | |
| 98 A.——vir. | | | | | * | * | | | | | | | | | | |
| 98*a* v. concinnus | | | | | | | * | | | | | | | | | |
| 99 A.—— Acadicus, Hartt | | | | | | * | | | | | | | | | | |
| 99*a* v. declivis | | | | | | | * | | | | | | | | | |
| 100 A.——bisectus | | | | | | | | | | | | * | | | | |
| 101 A.——partitus | | | | | * | | | | | | | | | | | |
| 102 A.——obtusilobus | | | | | | | * | | | | | | | | | |
| 103 A.—— acutilobus | | | | | | | * | | | | | | | | | |
| 104 A.——Nathorsti (at Drury's Cove) | | | | | | | * | | | | | | | | | |
| 105 A.——fissus | | | | | | | * | | | | | | | | | |
| 106 A.——pisiformis, L sp. | | | | | | | * | *? | | | | | | | | |
| 107 A.——umbo | | | | | | | * | | | | | | | | | |
| 108 A.——tessella | | | | | | | * | | | | | | | | | |
| 109 Microdiscus Dawsoni, Hartt | | | | | * | * | | | | | | | | | | |
| 110 Microdiscus punctatus, Salt, v. pulchellus, Hartt | | | | | | | * | | | | | | | | | |
| 110*a* v. precursor | | | | | | * | | | | | | | | | | |
| 111 Ellipsocephalus *cf*, polymetopus, Lnrs. | | | | * | | | | | | | | | | | | |
| 112 Agraulos articephalus | | | | * | | | | | | | | | | | | |
| 113 A.—Whitfieldianus | | | | | * | | | | | | | | | | | |
| 113*a* v. compressa | | | | | * | | | | | | | | | | | |
| 114 A.——holocephalus | | | | | | | * | | | | | | | | | |
| 115 A.——socialis, Bill. | | | | | | | * | | | | | | | | | |

FOSSILIFEROUS HORIZONS, ETC.—(*Continued.*)

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|  | Division 1. | Division 2. | Division 1. |  |  |  |  | Div. 2. |  |  | Division 3. |  |  |  |  |  |
|  |  |  | *a* | *b* | *c*¹ | *c*² | *d* | *a* | *b* | *c* | *a* | *b* | *c*¹ | *c*² | ? | *d* |
| **Trilobita**—(*Continued.*) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 116 A.——(Strenuella) Halliana |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 117 Liostracus tener, Hartt, sp. |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |  |
| 117*a* acuminate var. |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 117*b* smooth variety |  |  |  |  |  |  | *r |  |  |  |  |  |  |  |  |  |
| 118 L.—ouangondianus Hartt, sp. |  |  |  |  |  | * | *r |  |  |  |  |  |  |  |  |  |
| 118*a* v. immarginata |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 118*b* v. aurora, Hartt, sp. |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 118*c* v. gibba |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |  |
| 118*d* v. plana |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |  |
| 119 Ptychoparia Linnarssoni, Brög. sp. |  |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |
| 120 P.——alata |  |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |
| 121 Solenopleura Robbii, Hartt, sp. |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 122 S.——Acadica Whiteaves |  |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |
| 122*a* v. elongata |  |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |
| 123 Anomocare stenotoides |  |  |  |  |  |  |  | *? |  |  |  |  |  |  |  |  |
| 124 A.——spiniger |  |  |  |  |  |  |  | *? |  |  |  |  |  |  |  |  |
| 125 Conocoryphe Walcotti |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |  |
| 126 C.——Baileyi, Hartt, sp. |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 127 C.——elegans, Hartt, sp. |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 127*a* v. granulatus |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 128 Ctenocephalus Matthewi |  |  |  |  |  | * | *r |  |  |  |  |  |  |  |  |  |
| 128*a* v. geminispinosus Hartt, sp. |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 128*b* v. hispidus |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 128*c* v. perhispidus |  |  |  |  | * | * |  |  |  |  |  |  |  |  |  |  |
| 129 Paradoxides lamellatus, Htt. |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |  |
| 129*a* v. loricatus |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |  |
| 130 P.——Acadicus |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 130*a* v. suricus, |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |
| 131 P.——Eteminicus |  |  |  |  |  | * |  |  |  |  |  |  |  |  |  |  |

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| | | | *a* | *b* | $c^1$ | $c^2$ | *d* | *a* | *b* | *c* | *a* | *b* | $c^1$ | $c^2$ | ? | *d* |
| **Trilobita**—(*Continued.*) | | | | | | | | | | | | | | | | |
| 131*a* v. suricoides | | | | | | * | | | | | | | | | | |
| 131*b* v. breviatus | | | | | | * | | | | | | | | | | |
| 131*c* v. malicitus | | | | | | * | | | | | | | | | | |
| 131*d* v. quacoensis | | | | | | * | | | | | | | | | | |
| 132 P.——micmac, Htt. | | | | | | * | | | | | | | | | | |
| 132*a* v. pontificalis | | | | | | * | | | | | | | | | | |
| 133 P.——regina | | | | | | * | | | | | | | | | | |
| 134 P.——Abenacus | | | | | | | * | | | | | | | | | |
| 135 Parabolina spinulosa, Whl. sp. | | | | | | | | | | | * | | | | | |
| 136 P.——heres, Brögg. v. lata | | | | | | | | | | | | | | | | |
| 136*a* v. grandis | | | | | | | | | | | | * | | | | |
| 137 Parabolinella posthuma | | | | | | | | | | | | * | | | | |
| 138 Protopeltura acanthura, Ang. sp. | | | | | | | | | | | | | | | | * |
| v. tetracanthura | | | | | | | | | | | | * | | | | |
| 139 Peltura scarabeoides Wahl. sp. | | | | | | | | | | | | * | | | | |
| 140 Cyclognathus rotundifrons | | | | | | | | | | | | | | | | |
| 141 Leptoplastus latus | | | | | | | | | | | | | | | | * |
| 142 Ctenopyge flagillifer, Ang. sp. | | | | | | | | | | | | * | | | | |
| 143 C.——spectabilis, Brögg. var. | | | | | | | | | | | | * | | | | |
| 144 C.——pecten, Salt.? | | | | | | | | | | | | * | | | | |
| 145 Conocephalites contiguus | | | | | | | | | | | | * | | | | |
| 146 Euloma, sp. | | | | | | | | | | | | | | | | * |
| **Tracks, Burrows and Trails**— | | | | | | | | | | | | | | | | |
| 147 Medusichnites | | | | | | | | * | | | | | | | | |
| 148 Eoichnites Linnæanus, Torrell, sp. | | | | | | | | | | * | | | | | | |
| 149 Ctenichnites ingens | | | | | | | | | | * | | | | | | |
| 150 Psammichnites gigas, Torrell | * | | | | | | | *? | | *? | | | | | | |

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| | | | *a* | *b* | $c^1$ | $c^2$ | *d* | *a* | *b* | *c* | *a* | *b* | *c* | *c* | ? | *d* |
| **Tracks, Burrows & Trails**—(*Continued.*) | | | | | | | | | | | | | | | | |
| 151 Monocraterion magnificum | | | | | | | | | | * | | | | | | |
| 152 Arenicolites Lyelli, Torr, v. minor | * | | | | | | | | | * | | | | | | |
| 153 A.——brevis | | | | | | | | | | * | | | | | | |
| 154 Fræna ramosa | | | | | | | | | | * | | | | | | |
| 155 Goniadichnites trichiformis | | | | | | | | * | | | | | | | | |
| **Incerti sedis**— | | | | | | | | | | | | | | | | |
| 156 Eocoryne geminum | | | | | | * | | | | | | | | | | |
| 157 Lepidilla anomala | | | | | | * | | | | | | | | | | |

From this catalogue it will be seen that the middle and upper part of Division 1 in which the Cambrian fossils were first found, continues to be the richest collecting ground. Division 2, as a comparatively barren ground, divides the lower from the upper faunas. Fossils of the lower orders prevail in the Basal Series; but the Hydrozoa, with a few exceptions, show themselves abundantly only in the Upper division (St. John Group). The Linguellæ show their control of the Cambrian rocks by their uniform distribution; but the Trilobites, though abounding in the Upper and Lower divisions of the St. John Group, have left scarcely any remains in the intermediate strata.

The Agnosti in this list are arranged in three groups or sections; Nos. 97–100 are *Limbati;* 101–106 are *Longifrontes;* 107–108 are *Brevifrontes;* the fourth section of this genus, *Lævigati,* is unknown in the St. John Group. Of the three groups present it will be observed that the Limbati have the widest range, and that the Brevifrontes are confined to the horizon 1*d*.

COMMITTEE ON INVERTEBRATES.—A part of the fine collection of Invertebrate marine animals from Passamaquoddy Bay, presented to the Society by Prof. W. F. Ganong, have been mounted and placed on exhibition in one of the rooms of the museum. They are specially valuable for reference, as they have been compared with collections in Harvard Museum and the Museum of Comparative Zoology at Cambridge, Mass., and the names accurately determined. Many of these objects are the skeletons or shells of animals of economical importance, of which two groups—the Echinodermate and the Mollusca—were described in Nos. VII. and VIII. of the Sociey's Bulletin. They are therefore to the Canadian student of the Invertebrata and of the food products of the country, a valuable typical series of specimens. A suitable case for the preservation of this collection is greatly required.

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## DONATIONS TO THE MUSEUM.

| DATE. | DONOR'S NAME AND DESCRIPTION OF ARTICLE. |
|---|---|
| 1891<br>Mar. 3 | **W. D. MATTHEW.**—Piece of trap dyke with secondary growth of calcite. Laurentian. |
| June 24 | **SIR J. W. DAWSON.**—Series of photographs showing remains of reptiles from Joggins. Carboniferous. |
| | **J. BAXTER, M. D.**, Chatham, N. B.—Egg of Night Heron. Paper pulp made at Chatham. Flexible sandstone (*Itacolumbite*). Assam, China. |
| Sept. 29 | **REV. J. M. DAVENPORT.**—Sponges, Coral, Chiton, Echini from Bermuda. |
| Oct. 17 | **GEORGE HAMILTON.**—Small stone tomahawk from Virginia. |
| | **MR. MARSHALL REED**, Campbellton.—*Chalimilla oculata* from Frith of Forth. |
| 31 | **H. F. PERKINS.**—Wasp's nest. Eggs of lizard and snake. Lancaster, N. B. |
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# LIST OF FOSSILS OF THE CAMBRIAN ROCKS NEAR ST. JOHN.

## ERRATA.

The following errors occur in the columns of this catalogue:

No. 27 The mark (asterisk) is opposite No. 28.
No. 28 The mark is opposite Loganograptus.
No. 66 The mark is opposite No. 67.
No. 67 For Clytie, Hall, read Meneviæ, Hks.
No. 77 & 78 For Cyrtotheca read Creseis.
No. 106 Does not occur in Division 1*d*.
No. 112 For Agraulos read Ellipsocephalus.
No. 124 The mark is opposite No 125.
Nos. 140, 141 and 142 The marks for these are respectively one line too low in the page.
No. 143 The mark is omitted, but should be in Division 1*b*.

Also:

At page xii, line 8 of the text, for Linguellæ read Lingulellæ.
“ “ “ 17 “ list “ Incerti read Incertæ.

## ADDENDA.

Band *b* of Division 1 also contains:

112*a* Ellipsocephalus galeatus, n. sp.
112*b* E——— grandis, n. sp.
134*a* Protolenus elegans, n. gn. & sp.
134*b* P———paradoxoides, n. sp.